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ENGINEERING • CONSTRUCTION • OPERATIONS

PIPE LINE INDUSTRY

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Communications and Control Report

CONTROL ADVANCES
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Part of J. P. Neill's spread at work on a line near Laurinburg, N. C. An official of the company reports: "The No. 572 is the best all-around pipelayer you can put on any spread. We know from experience it will handle hard jobs with ease."

TOUGH PIPELAYING PAIR

These are just two of a number of Caterpillar Pipelayers used by J. P. Neill on the North Carolina Natural Gas Corporation's line near Laurinburg, N. C. A D7 is lending a hand through swampy ground that, along with rolling hills of sandy clay, makes up the right of way. The spread's on schedule—just what you'd expect with these pipelayers.

Big features on this tough pair account for their productivity . . . plenty of dependable engine horsepower to push the machines through hard going like this with power left over to handle a long string of heavy pipe.

The No. 572 Pipelayer shoulders 86,000-pound lifts and maneuvers with finger-tip ease . . . thanks to hydraulic boosted steering. The torque converter drive lets the pipelayer inch along with full power.

The MD7 is close to the No. 572 in lift capacity and features. The same hydraulic boosted steering system plus the easily engaged and disengaged Cat exclusive oil clutch account for the ease of maneuvering the MD7. And that famous oil clutch typically gives an entire hard-work season without even an adjustment. Both machines take top awards in dependability and high production at low cost with less job time for maintenance.

SEE YOUR CATERPILLAR DEALER

Get the facts about these two rugged pipelayers and learn about the other Caterpillar machines that have earned *and maintain* the reputation for high production at low costs even in the worst conditions.

Ask your Caterpillar Dealer for a demonstration. Make it rough—see for yourself how easily Cat machines handle the hard work.

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

CATERPILLAR

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TOUGH MACHINES
FOR THE HARD WORK

PIPE LINE INDUSTRY

CONTENTS and Quick Look

November 1959 gpc Vol. 11, No. 5

To help you put first things first, scan these time-saving digests, checking ☑ those you want to read first.

COMMUNICATIONS AND CONTROL REPORT

El Paso's New Station Has Latest in Controls.

☐ Design engineers have come up with a highly satisfactory combination for automatic control in this new station at Seligman, Ariz. Two 5,000 horsepower units are operated from the Williams station, 45-microwave path miles upstream. Station suction and discharge pressures, motor power loads and compressor guide vane positions are only values telemetered to control point. First months of operation have proved good equipment performance and high reliability of communications and control facilities.

By Melvin A. Judah ..... Page 40

Designing Large Outdoor Pump Station For Maximum Economy.

☐ Magnolia Pipe Line Company has just finished expanding its Corsicana-Beaumont pipe line system to its economic limit. Two of the outdoor intermediate stations are operated remotely from Corsicana. They are designed for minimum operating expenses: normally, suction and discharge valves are wide open!

By J. R. Ashley ..... Page 47

Fuel Cells Power Tractor!

☐ Ideas of the future are here today! A bank of 1,008 fuel cells interconnected under the hood of a farm tractor are producing 15 kw of electricity—enough to power a high torque DC electric motor giving the tractor a drawbar pull of 3,000 pounds. These cells convert a mixture of gases—largely propane—and oxygen directly to electricity. The efficiency is better than double that of conventional units..... Page 52

Eddy-Current Coupling Provides Economies, Improves Efficiency.

☐ This device, long accepted in other industries, is producing some surprising results in pipe line stations. It provides excellent controls for electric-centrifugal pump stations; in the future it will probably find great usage as a key instrument in pump station controls.

By E. C. Michels..... Page 54

What's New in Telemetering and Flow Controls?

☐ We have good equipment today; but there is better equipment available. It comes from the aircraft and missile industry, and where conditions warrant, it can be applied to pipe line problems. The main advances center around faster speed of response and the use of single-case transducers.

By B. C. Joyce..... Page 59

Let's Keep Automatic Controls Simple But Adequate!

☐ So says the "old pro" in automatic controls. New control "hardware" is hitting the market daily; and before we get swept up in a myriad of gadgets, let's take a look at just what functions we are trying to control and why we are trying to control them. Simplicity and purpose are still virtues of the design board.

By Sydney S. Smith..... Page 64

How Transco Cut Tower Maintenance Costs.

☐ By using spray painting methods, one crew cleaned and painted 55 towers in 42-working days. Two contractor's men, plus the company inspector, scraped, wire brushed and painted the system's microwave towers with only two days lost because of bad weather. High winds caused this shutdown, but there were virtually no problems caused by paint floating onto adjacent property. This method cut costs 20 percent and gave good coating coverage.

By Jay C. McElroy..... Page 72

Be Sure You Write What You Mean!

☐ If at times your writing is either misinterpreted or ignored, then more than likely you have a communications problem. Here, however, are some helpful pointers which will enable you to greatly improve your letter and report writing.

By B. J. Wachter..... Page 77

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Why not join forces?

INDUSTRY AND GOVERNMENT are approaching a major showdown.

The issue: Excessive government control.

The arena: Courts and Congress

The stake: Free enterprise

At present, free enterprise opponents have an advantage. They agree on their arguments and work together to put them across. In contrast, the industries involved are not working together. Although faced with the same threat, each industry is fighting its own case—alone.

Two examples are the investor-owned electric power and petroleum industries. Both are regulated by government. The electric power industry is regulated as a public utility. The petroleum industry is regulated as a natural-resource business.

Both are heavily taxed by all government agencies. And the amount of taxation is increasing. Taxation can destroy both industries.

Both are socialist objectives for government ownership and operation. If either industry is taken over by government, a drive to nationalize the other industry will soon follow.

It must be emphasized that the issue is not reasonable government control, but excessive control. Sound regulation in the interest of owners, employes and customers always has been accepted by the electric and petroleum industries. The electric industry accepts rate regulation. The petroleum industry accepts proration of production and the regulation of pipe lines as common carriers.

There are those, however, who would excessively regulate and tax both industries for the purpose of achieving government ownership. Such control would thus invade and narrow to extinction the field of managerial discretion and responsibility.

Also, the government ownership proponents would no longer tax the two industries solely for revenue purposes, but rather for social and other objectives. Taxation would become another instrument for bringing about government ownership of the electric and petroleum industries. Confiscatory taxation forces owners to sell out to government.

Government ownership advocates are clever enough to conceal their true motives and to gain support of the general public for stricter regulation and higher taxation. Therefore, it is imperative that the electric and petroleum industries work together to keep free enterprise a reality.

Common objectives. The triumvirate of forces—regulation, taxation and government ownership—creates an urgent need to carry out three objectives common to both industries:

1. To keep regulation sound and workable and administered for the sole purpose of obtaining a balance between stockholders, operators and consumers.

2. To keep taxation within reasonable limits and imposed for revenue purposes and not for the purpose of destroying the two industries as tax payers.

3. To defeat the ambitions of total government ownership advocates who would take both industries over, and who do not hesitate to use regulation and taxation to accomplish their goal. At the same time, both industries must oppose tax-financed and tax-subsidized competition against either or both industries.

For the good of all, the electric and petroleum industries must remain in private hands. The two industries must maintain a vigilant alliance for self-defense.

When the showdown comes, let us hope that not only the electric and petroleum industries, but all businesses affected will join forces to protect free enterprise—the economic force that has created the world's highest living standard.

PIPE LINE PANORAMA

New Advances in Pipe Line Equipment and Facilities . . . El Paso's new Seligman, Arizona electric station (two 5,000-hp units) is microwave-controlled from Williams station 45 miles away. Values telemetered to control point include motor power loads, compressor guide vane positions, station suction and discharge pressures. (See Page 40).

"Engineless" tractor is now in advanced experimental stage. Commercial-sized farm tractor is powered by mixture of fuel gas—largely propane and oxygen—which reacts in an electrolyte within 1,008 fuel cells. Enough power is provided (15 kw of electricity) to run high torque DC electric motor with drawbar pull of 3,000 pounds. (See Page 52).

Two Pipe Lines for Alaska? . . . Anchorage Gas Corporation is considering plans to build two 12-inch gas lines from Union and Ohio Oils' gas find on Kenai Peninsula to Anchorage. **Anchorage Gas already has obtained franchise** in Alaska's largest city, and has signed agreement to supply gas from Kenai Unit 1.

Imported Propane—a Definite Possibility . . . According to Texas Eastern, there is long range prospect (5-15 years) that propane may be brought to Gulf Coast ports, stored in salt domes, then shipped to points of consumption.

Prediction was made during opening of the company's Mont Belvieu underground storage terminal 25 miles east of Houston. New terminal now has one 329,000-barrel salt dome storage well. Eventual capacity: Up to 9 million barrels. Cost to etch salt dome facilities: About 50 cents per barrel of propane.

Shorter Union Security Period Under New Law . . . Union Shop Contract under Taft-Hartley Act allowed employers and labor organizations to sign contracts that required a man to join a union or be terminated from employment within 30 days after taking a job.

Under 1959 Labor Law, 30-day period is reduced to 7 days. Pipe Line Contractors Association anticipates that when new contracts with Pipe Fitters and Laborers-Operating Engineers are negotiated next year, the 7-day period will be demanded.

Pipe Line Panorama . . . Pipe line construction will start to feel tight pinch of steeel shortage after January 1, with some companies delaying projects as early as December . . . **Interior Secretary Seaton has asked oil and gas industry to submit new natural gas bill,** preferably in 1961, indicating that if certain requirements are met, administrative support can be expected no matter what party is in office . . . **American Association of Petroleum Geologists President Lewis G. Weeks predicts that more than half of total fuel requirements** will be met by shale oil, coal-derived petroleum, solar, geothermal, and tidal energy by 2059. Fuel consumption will be 40-50 times greater than now . . . **FPC has given Transco green light** to increase its capacity 155 million Mmcf daily. Cost: $53 million . . . **American Gas Association President Theodore Wolfe predicts there will be 45 million natural gas customers by 1970**—and gross plant investment will be 2½ times what it is today . . . **Construction has started** on Transwestern's 1,500-mile, $191 million gas line from West Texas to Arizona-California border.

El Paso's New Station

By Melvin A. Judah, Editor
PIPE LINE INDUSTRY

IN RECENT YEARS, gas pipe line companies have made big strides in the design of controls for compressor stations to achieve a top safety record and maximum economy in operation. One of the most significant developments in the past year is that of El Paso Natural Gas Company's design of new electric motor-centrifugal compressor units at its Seligman and Leupp stations. These stations feature many of the latest ideas in microwave communications, telemetering, and supervisory control which are now being field proven in initial operations. In the first 10 months since start-up, operators have experienced good equipment performance and high reliability with both controls and communications facilities.

From many years' experience in operation of reciprocating stations and as an engineering pioneer in development of the gas turbine for pipe line service, El Paso's engineers had a wealth of design experience. But this was their first installation of the electric-centrifugal units. However, they felt that the features of these units should make them one of the easiest types to control in gas pipe line operations, either locally or remotely. With all rotating machinery, few moving parts, and no fuel fired equipment, they were expected to provide few maintenance problems and a basic design simplicity. If future operation of the Seligman station continues as promising as its initial operating runs, this will surely prove true.

Seligman Station Design. At Seligman, two 5,000-horsepower synchronous electric motors drive centrifugal compressors through single step, gear speed increasers. The electric motors are rated at 4,160 volts 1,200 rpm, on three phase 60-cycle power, with a power factor of 1.0. Motors are designed to operate at 115 percent of load continuously.

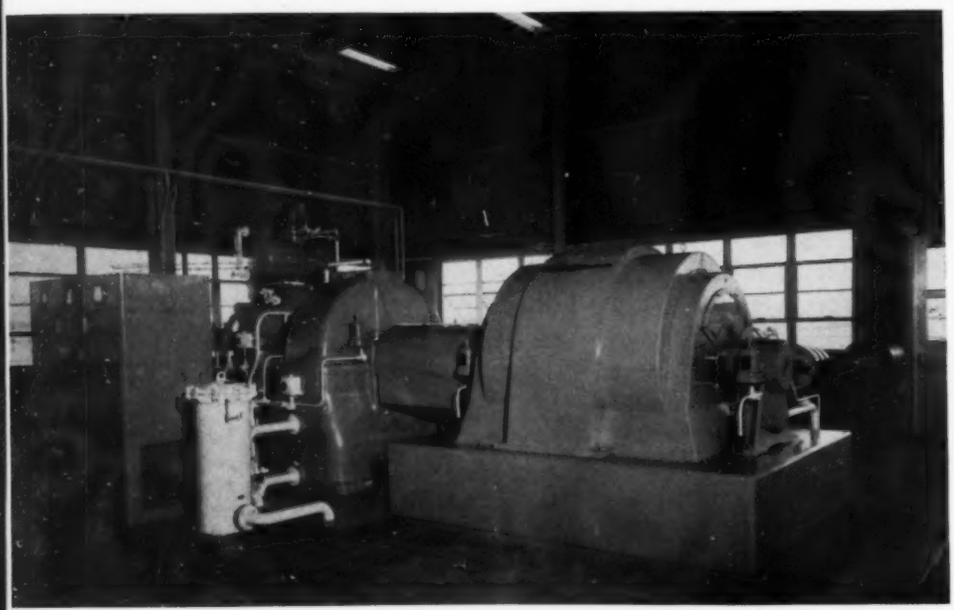
Centrifugal compressor units at Seligman are equipped with movable inlet guide vanes having a range of settings from 20 degrees counter-rotation to 70 degrees pre-rotation. The compressors' normal operating speed is 6,850 rpm using a 23-inch impeller. Compressors are flange fitted to 24-inch piping. Design point of the centrifugal compressor is 8,500 cubic feet per minute at the compressor inlet and 6,750 feet of head. In normal operation, the Seligman station has a suction pressure of 710 psia; a discharge pressure of 799 psia. This gives a compression ratio of 1.125 handling 1,364 million cubic feet per day at a 14.73 psi and 60° F base.

Guide Vane Operation. A small electric motor, located on the face plate of the compressor, positions the guide vanes to control gas flow into the eye of the impeller. Vanes may be positioned by handwheel or remotely from either the Seligman control console or from Williams, Ariz. A digital encoder bolted onto the compressor housing indicates guide vane position and also changes in position. Two micro-switches limit "over positioning."

Speed Increaser. Power is delivered from the motor through a single step, gear type speed increaser, having a 1,200 rpm input and 6,850 compressor shaft speed. The speed increaser also drives two pumps, the main lube oil pump and seal oil pump, off the motor and compressor shaft stubs. The "sump" of the increaser serves as a lube oil reservoir for the electric motor bearings, compressor bearings and seal oil, and for the increaser itself.

Motor Cooling. Air for the forced draft motor ventilating system is picked up on the "windward" side of the station, filtered through a multi-duty type air filter which is rated at 1,200 cubic feet per minute. Electric motor cases are maintained under positive pressure; warm air from the motors is discharged on the manifold side of the compressor station.

Lube Oil Cooling. Two atmospheric



At El Paso's Seligman, Ariz., station 5,000 horsepower synchronous electric motors drive centrifugal compressors through single step gear speed increasers. Two such units are controlled from a station at Williams, 45 microwave miles upstream.

Has Latest in Controls

finned-tube cooling units are used to cool lube oil in a unitized design. Temperature is controlled by regulating flow by means of a three way control valve and by varying the pitch of the constant speed propellers. Fans are driven by electric motors. Separate piping is provided for each motor-compressor unit.

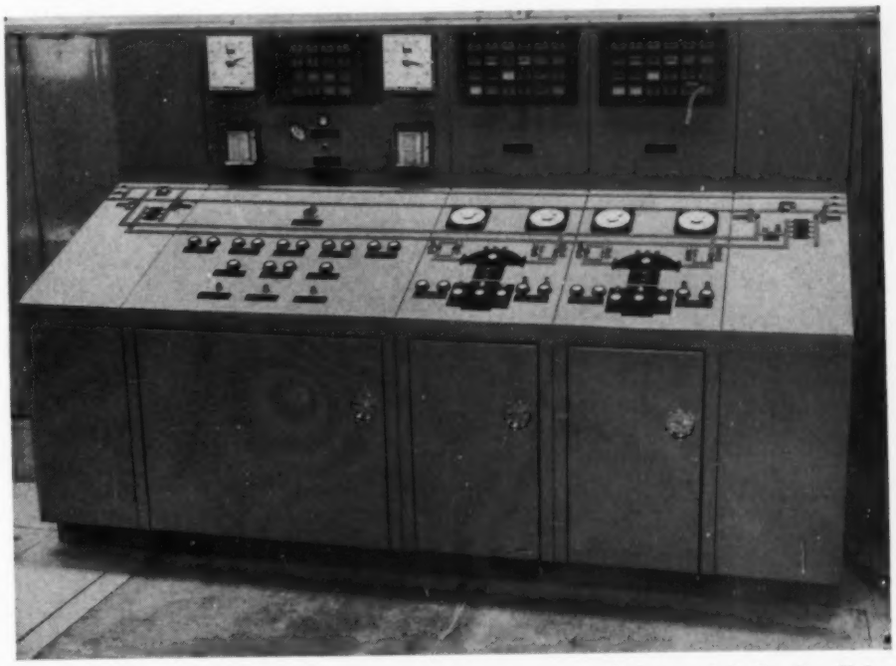
No provision has been made for oil heating when units are down. However, standby space heaters are provided in the main motor cases. A general purpose turbine oil is used for lubrication; rust and foam inhibitors are added.

Yard Piping. Gas entering the Seligman station passes first through four 66-inch horizontal scrubbers. The 30-inch, 0.875 wall yard piping is designed to provide a gas velocity of not greater than 2,500 feet per minute in parallel operation of scrubbers and of compressors. Valve actuators have been modified with a novel pilot system which permits reducing control pressures from 150 down to 60 pounds.

Future Expansion. Provision was made in design of El Paso's Seligman station for addition of four more similar units in the future. The station may be controlled either locally or remotely from Williams by a microwave link. Necessary operating information is telemetered back to Williams from Seligman.

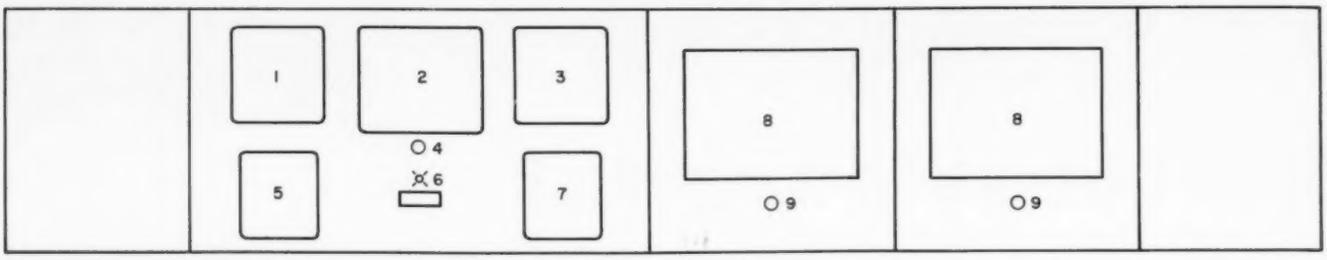
Microwave Link. The Seligman station is controlled over a 44.9 mile microwave path from Williams. The 2,000-megacycle, narrow-band microwave system has 100 percent standby facilities. Two primary voice channels, a service voice channel, two supervisory control channels and one telemetering channel are being used at present. Present capability of the microwave equipment is 30 channels which provides plenty of room for future expansion. In addition, Williams station presently has a teletype channel which is not actually a part of the control circuitry.

El Paso's Williams-Seligman microwave control system provides three frequencies from Seligman to Williams and two frequencies back to Seligman.

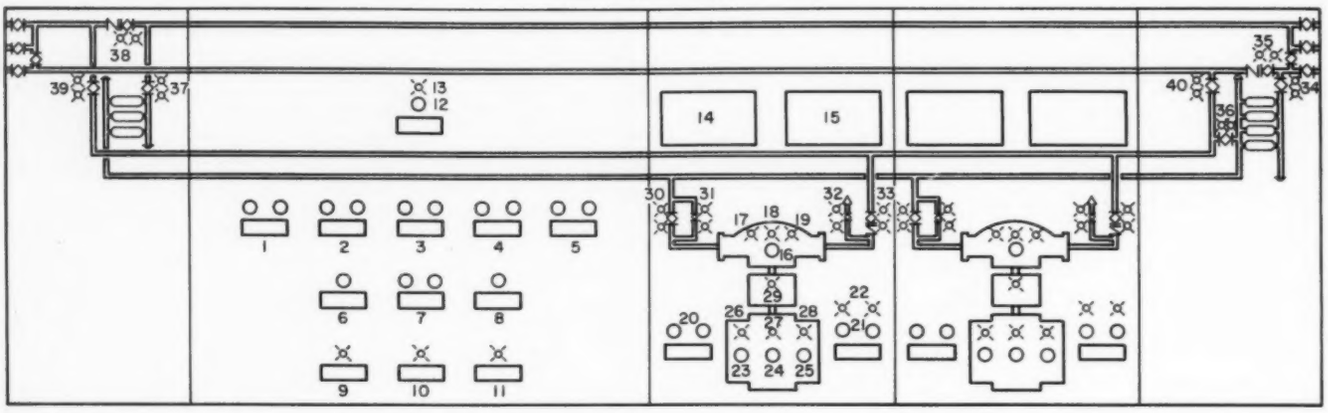


Control console at Seligman contains all the necessary switches and indication lights for local operation. Normally, the station is operated remotely, however all control functions needed for emergency operation or station check-out can be performed here. Desk panel contains unit and station function switches and lights. Vertical panel has annunciators and local indication of telemetered data.

Williams station control console has section at left for controlling Seligman station remotely. Console at right is for compressors installed at Williams. From here, operator can perform all start-up, stop, and emergency stop functions at Seligman as well as check telemetered data on suction and discharge pressures, electric motor power load, and guide vane positions.



Vertical Panel Layout



Sloping Panel Layout

SLOPING PANEL LEGEND

1. 24-inch and 30-inch station discharge block valve switch open-close
2. 24-inch and 30-inch station bypass valve switch open-close
3. 24-inch and 30-inch station suction block valve switch open-close
4. 34-inch station bypass valve switch open-close
5. 34-inch station suction block valve switch open-close
6. Lamp test and switch
7. Surge control bypass valve switch open-close
8. Alarm silencer switch
9. Communication fault light
10. Pressure rate of change alarm light
11. Plant AC power failure light
12. Station emergency shutdown switch
13. Station emergency shutdown light
14. Guide vane position readout
15. Motor KW readout
16. Reset lockout switch
17. Alarm only light
18. Shutdown/restart light
19. Shutdown/lockout light
20. Guide vane control switch. Pre-rotate—counter-rotate
21. Local-remote unit control switch
22. Local-remote unit control lights
23. Motor stop switch
24. Motor start switch
25. Motor start, load switch
26. Motor stop light
27. Motor start light
28. Motor start, load light
29. Sequence complete light
30. Unit suction valve lights open-close
31. Unit pressurizing valve lights open-close
32. Unit vent valve lights open-close
33. Unit discharge valve lights open-close
34. 34-inch station suction. Block valve lights open-close
35. 34-inch station bypass valve lights open-close
36. Surge control bypass valve lights open-close
37. 24 and 30-inch station suction block valve lights open-close
38. 24 and 30-inch station bypass valve lights open-close
39. 24 and 30-inch station discharge block valve lights open-close
40. 34-inch station discharge block valve lights open-close

THESE FUNCTIONS ADDED ON WILLIAMS PANEL

On-demand readout switch
Permissible transmission light
Station suction pressure readout
Station discharge pressure readout

VERTICAL PANEL LEGEND

1. Suction pressure indicator and transmitter
2. Station annunciator
3. Discharge pressure indicator and transmitter
4. Station annunciator reset
5. Plant suction and discharge pressure recorder
6. Ground detector light
7. Plant suction and discharge temperature recorder
8. Unit annunciator
9. Unit annunciator reset

Control console layout at Seligman. Sloping panel legend shows lights and switches used for control and indication of operations.

Vertical panel has annunciators and displays for data being telemetered to the Williams control point.

Frequency shift tones are used in the supervisory and telemetering systems to minimize noise interference and improve reliability.

One unusual feature of this system is the relay station atop Mt. Floyd about 8 miles north of Seligman. At this point, the system ties into El Paso's main microwave link between the San Juan basin and Topock, Ariz. Although the Seligman-Williams circuit makes up a separate system, it is interconnected with El Paso's main communications facilities. At Mt. Floyd the system makes a four way junction utilizing two transmitters eastward, one west along the main line, and one south to Seligman.

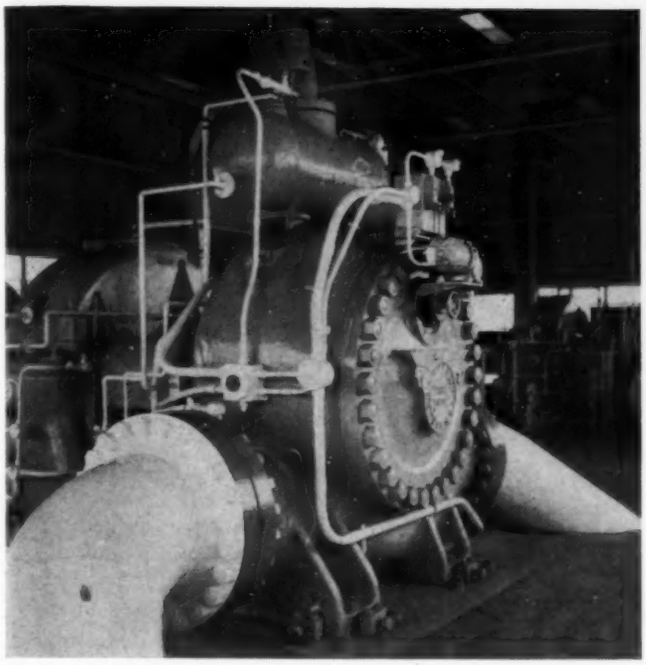
Emergency Microwave Power Supply. Power is supplied to the microwave system by an AC-DC-AC motor generator set. An AC motor drives an AC generator to supply power for the microwave system; on the same shaft is a DC motor and heavy flywheel. In the event of AC power failure the field to the DC motor is energized by the battery bank and AC power is supplied without interruption to the microwave equipment.

All supervisory and telemetering equipment operates off the standby battery bank DC supply. Batteries are continuously recharged from the main AC power source.

Telemetering. El Paso technicians built their own multiplex racks to convert pulse codes into tones for transmission. From Seligman, station suction and discharge pressures, kilowatts supplied to each motor, and guide vanes' positions are converted by disc type encoders to digital form. They are then translated into a standard teletype code and transmitted on the audio tone carrier in pulse sequence form at the rate of 60 words per minute. At Williams, signals are decoded, checked, and then displayed in digital form.

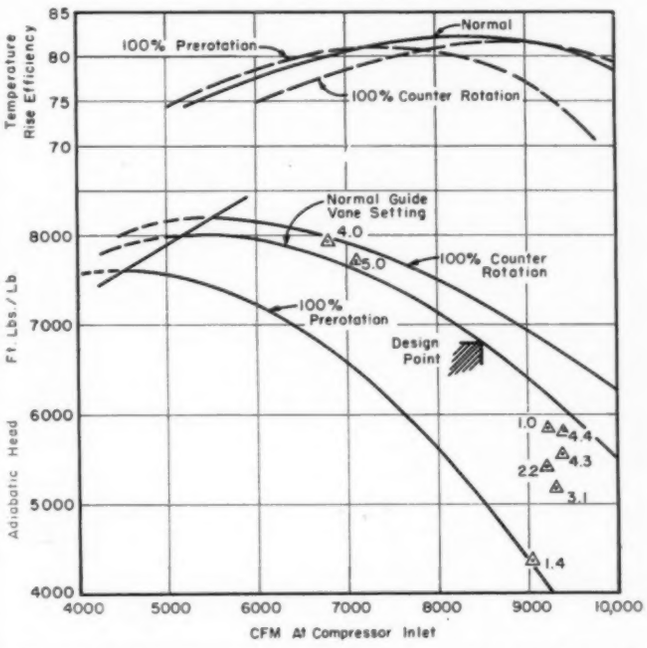
All readings are transmitted once every hour, or on demand by supervisory control when the operator asks for a readout. Digital display units on the Williams console continue to indicate the last reading until a new reading is transmitted. If the remote station suction or discharge pressures traverse set thresholds at every four or six psi, a transmision of all telemetered data will occur automatically. In addition, should station suction or discharge pressure change at a rate faster than 20 psi in 10 seconds, an automatic transmission of all telemetered data will occur.

Each character is transmitted twice.



Small electric motor, installed on face plate of compressor, positions guide vanes and directs gas flow into the eye of the impeller. Vanes may be positioned either by handwheel or remote control between settings of 20° counter-rotation to 70° prerotation. A digital encoder on the compressor housing indicates guide vane position to operator at Williams.

Four 66-inch horizontal scrubbers clean gas entering Seligman yard piping. Station piping is 30-inch, 0.875 wall. Gas velocities are limited by design to 2,500 feet per minute.



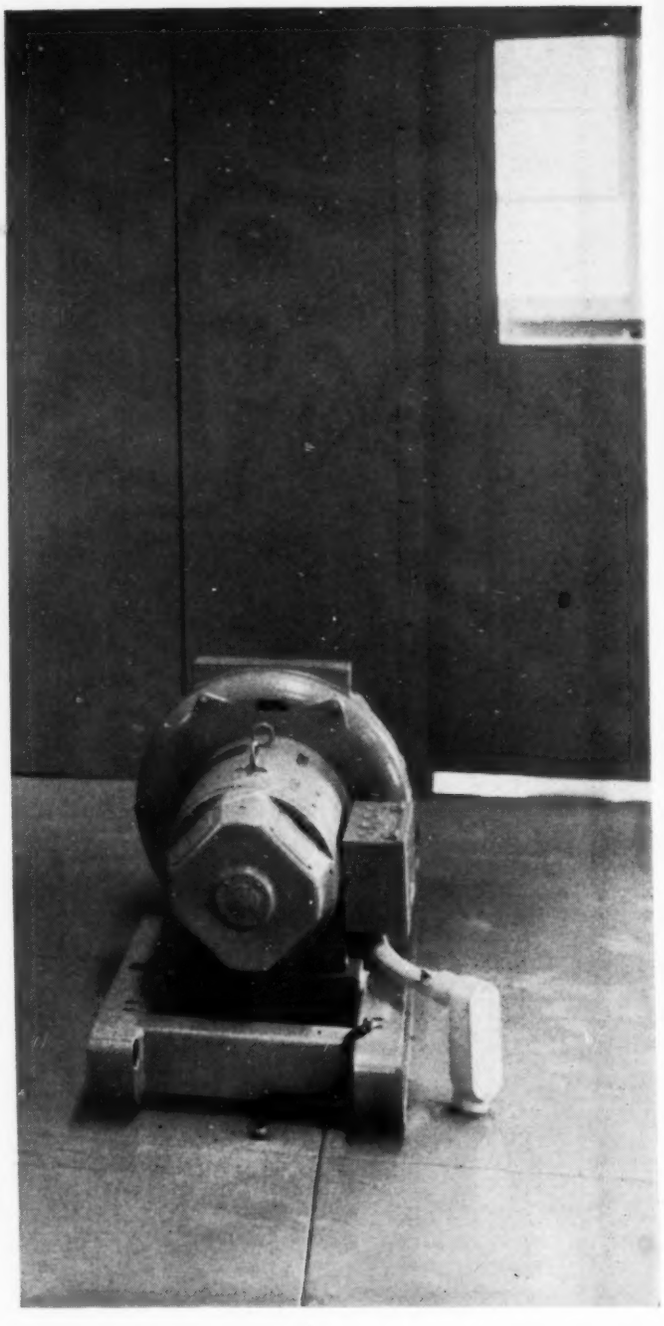
Curves of performance characteristics for constant speed centrifugal compressors show effect of guide vane rotation on temperature rise efficiency and adiabatic head for various capacities. These curves are for a speed of 6,850 rpm, using a 23-inch impeller.

Microwave and telemeter panels for Williams-Seligman control link. The 2,000 megacycle, narrow band, microwave system has 100 percent standby. Two primary voice channels, a service voice channel, two supervisory channels and a telemetering channel are being used at present. Telemetered readings are transmitted every hour, when significant changes occur or on demand of the operator.

and displayed once if both transmissions are duplicate. If they are not, an error is acknowledged and a demand readout is automatically initiated. In the event of an error, the readout display will show a complete set of zeros.

Telemetering equipment at Williams is arranged for future addition of a teletypewriter for automatic typeout of data. El Paso's telemetering system has two "sequential encoders"; one was furnished as an "installed spare." This device pulses the coded signals into the audio tones. A three-position switch provides for local testing of the alternate sequential encoders. To insure the power source, a "trickle" charger is mounted on the telemetering rack to supply the 48-volt telemetering battery bank. Fuses

Supervisory control and sequencing panel at Seligman. To operate units remotely the operator pushes the "Start" or "Start-load" buttons on the console; if all permissive conditions are met in the equipment at Seligman an acknowledgment is returned to the control point and a second signal initiates that control function. Frequency shift tones are used in the supervisory and telemetering systems to minimize noise interference and improve reliability.



Small, but heart of the microwave communications link which is designed for 100 percent reliability, is this AC-DC-AC motor generator unit (right). Normally, its AC motor drives an AC generator to supply power to the microwave system, but in the event of an AC power failure, the field of its DC motor on the same shaft becomes energized so that continuous power is supplied without interruption. A "trickle" charger keeps the 48-volt battery bank fully charged during normal operations.

for these circuits are located on the panel.

The audio tone is monitored by time drop-out relays; tone or microwave failure will sound an alarm. If the communications channel were to be lost completely, the Seligman station would operate on its last setting until some abnormal local condition would arise which would shut it down automatically.

How Control Functions. To operate the Seligman units from Williams, a supervisory signal is first sent; if all permissive conditions at Seligman are met, an acknowledgment comes back. A second signal then initiates the actual control function. A third tone to Williams performs the telemetering step.

Remote Operating Sequence from Williams. Prior to the start up of the Seligman station the following conditions would normally exist there:

1. Station suction, bypass, and discharge valves are open, station vent valve is closed; all done by local operator at the valves.

2. All unit valves are closed, except the unit vent is open from last normal shutdown.

3. AC and DC voltage is available.

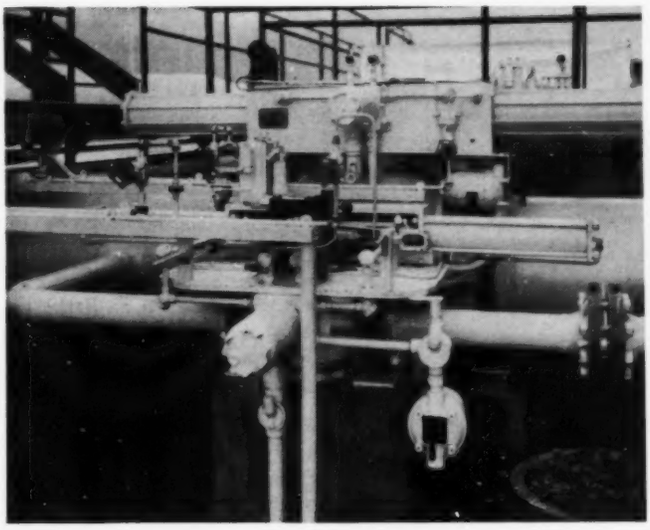
4. Unit *local-remote* switches are in desired position.

5. Control room pressurizing fan running.

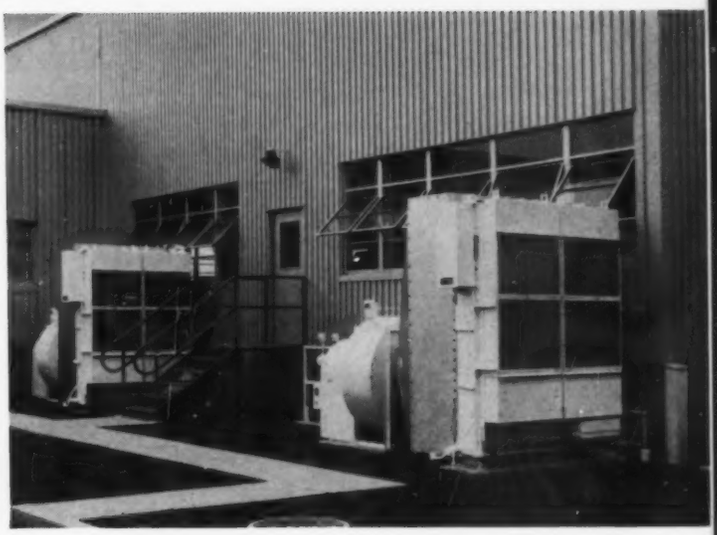
Starting the Units

1. Starting signal for any compressor unit may be initiated by pushing the *start* or *start-load* button at either the master (Williams) or remote (Seligman) station.

2. At this signal, the motor driven lube pump, ventilating fan, oil cooling fan, and exciter motor-generator set for the unit start and run. The main motor space heaters are de-energized



Automatic valve operators on compressor suction and discharge lines were modified with a new pilot system which permits reducing control pressures from 150 down to 60 psi. Operators have speed control in either direction; the first 30 percent of travel on unit suction valve opening has also been speeded up.



Air for the motor cooling system is taken from the "front" side of the station and filtered through these 1,200 cfm units. Motor cases are pressurized; warm air is discharged in the manifold area on the opposite side of the station.

when ventilating fan starts. Sequence timer starts timing.

3. Seal oil tank fills.

4. The motor driven lube pump runs until the shaft driven lube pump is up to speed; then lube oil pressure switch shuts down the motor-driven pump.

5. After the seal oil tank is full, its seal oil level switch initiates opening of pressurizing valve and closing of the vent valve. Speed of vent valve closing, which is adjustable at the valve, allows for an adjustable purge time.

6. When compressor case pressure reaches approximately 120 psig, the pressure relays signals the pressuring valve and the main motor-breaker to close, provided that the lube oil pressure switch and motor-ventilating switch indicate acceptable conditions.

7. Then the main motor accelerates and automatically synchronizes.

8. If gas temperature exceeds limit, as indicated by relay, the motor is shut down.

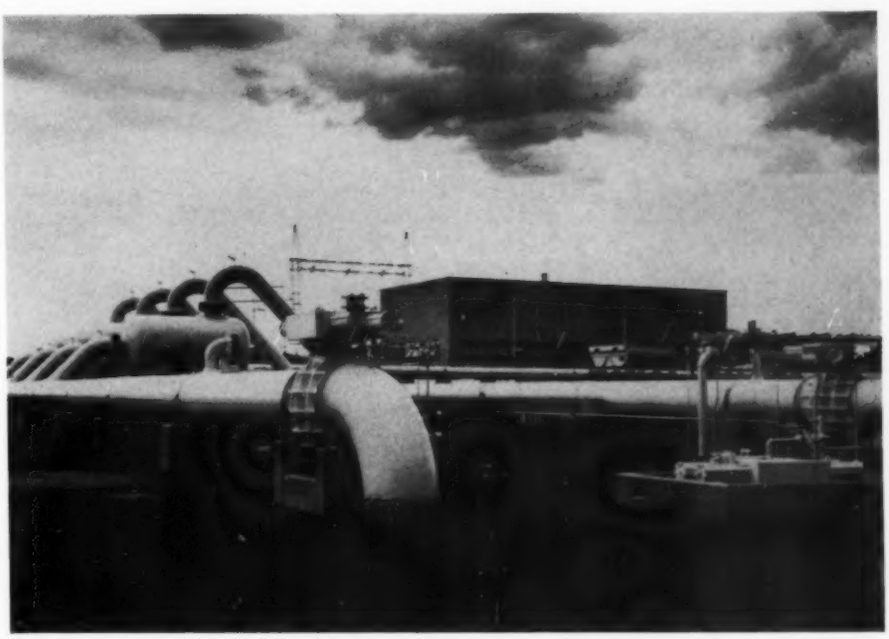
9. At this point the operator (master or remote) may push *motor-start-load* button; valve sequencing proceeds. (If under step one above, the operator had pushed *motor-start-load* button, the valve sequencing would proceed automatically after motor had synchronized.)

10. Pressurizing valve then opens fully.

11. When case pressure switch indicates 400 psig, pressurizing valve closes; discharge valve opens.

12. When discharge valve is fully open, suction valve starts opening and is under its own time-opening control.

13. After suction valve arrives at fully open position, the complete sequence is indicated. If (5-60 minute) complete sequence timer has not timed out, it is de-energized.



Over-all station view shows yard piping design features. Throughout station design, provision was made for addition of up to four more automatic units in some future expansion.

How Units are Shutdown—Local or Remote:

1. Pressing of the local or remote operator's *stop* button opens motor breaker.

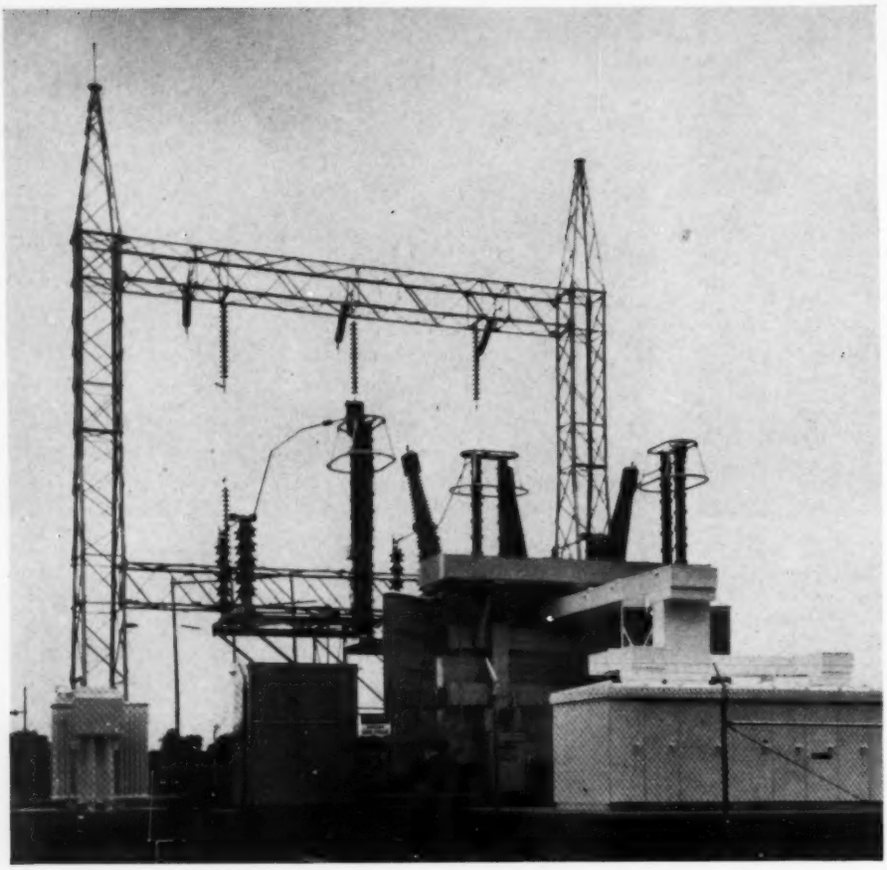
2. When breaker opens, suction and discharge valves close.

3. After discharge, suction, and pressurizing valves are fully closed, the unit vent valve opens.

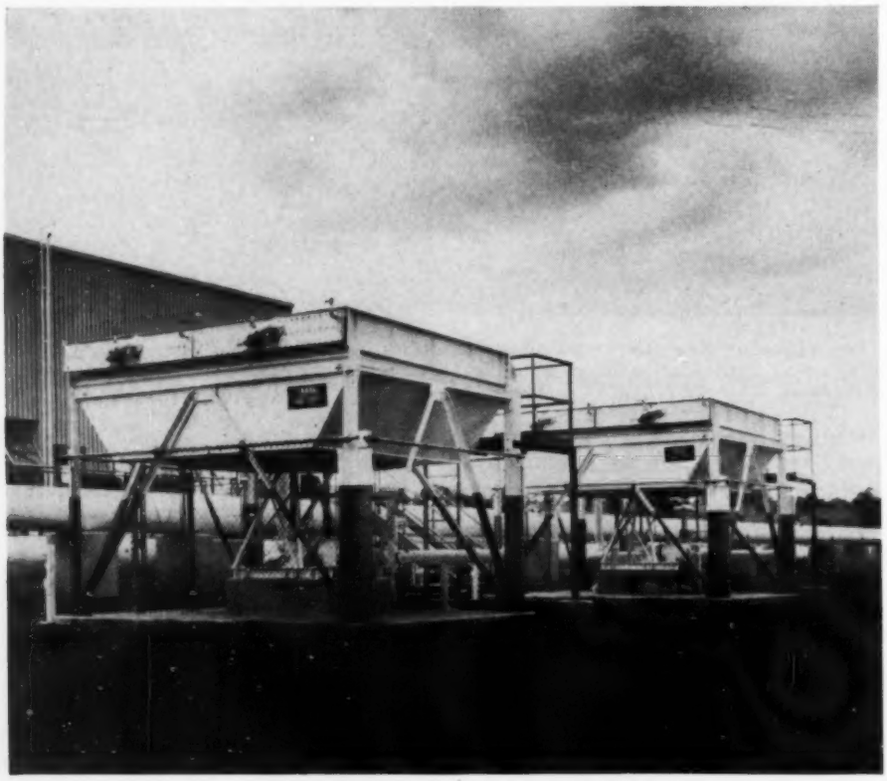
4. When vent valve is fully open, a complete sequence is indicated.

Seligman Emergency Shutdown Sequence:

1. When operator pushes the *emergency* button (there is one on both the local and remote desks and also one outside), or on low station suction pressure, all 4.16-kv breakers (except



Outdoor switchgear is metal clad, 4,160 volt, 250 MVA, interrupting duty, 60-cycle, 3-phase equipment. A 3,000-ampere buss connects to Arizona Public Service Company's transformer.



Lube oil cooling units feature unitized design with separate piping and controls for each unit. Oil temperature is controlled by means of a three-way control valve and by varying the pitch of the constant speed propellers. Fans are driven by electric motors.

Alarm and Shutdown Conditions

In the following list of alarm and shutdown functions associated with each compressor unit or for general station equipment, the letter A indicates an annunciator drop at seligman and alarm only. Letters S-L indicate the compressor unit is locked out and may not be restarted until the operator resets that function locally. S-R indicates the compressor unit has been shutdown, but may be restarted once only by local or master operator; after that attempt, restart is possible only when the operator resets locally (provided restart sequence has not passed motor-field application point prior to the second shutdown).

Unit Conditions	Action
Low lube oil pressure	S-L
Low seal oil level	S-R
Low lube oil level	A
Lube oil cooler fan not running	A
High gear vibration	S-L
High compressor vibration	S-L
High compressor bearing temperature	S-L
High gear bearing temperature	S-L
High motor bearing temperature	S-L
115 percent motor current	A
High motor winding temperature	S-R
Loss of motor air pressure	S-R
High gas temperature	S-R
Motor protective trip (includes motor differential, motor incomplete sequence, current unbalance, short circuit, split winding, armature winding)	S-L
Note: Underfrequency, units 2-6 interlock, field breaker opening, and motor incomplete sequence timer will also shut motor down, but are not lockout or restart functions.	
Lube-cooling fan vibration	S-L
Complete sequence timer	S-R

Station Conditions	Action
Low control room air pressure	A
480-volt undervoltage	S-R
125-volt DC undervoltage	S-R
Motor bus differential relay	S-L
High gas discharge pressure	S-R
Low gas suction pressure	S-L
Station AC power failure	A
Instrument air supply pressure	A
4.16-kw system ground	A

Unit 1) trip, and station suction and discharge block valves close.

2. Upon loss of 4.16-kv voltage or underfrequency, three motor-breaker units will trip.

3. When these motor-breakers trip, each unit shuts down according to the "Unit Shutdown Sequence" outlined above. —**The End**

Designing Large Outdoor Stations for Maximum Economy

The remotely operated intermediate stations at Grapeland and Bragg on Magnolia's Corsicana-Beaumont line are designed for unattended operation and minimum expense

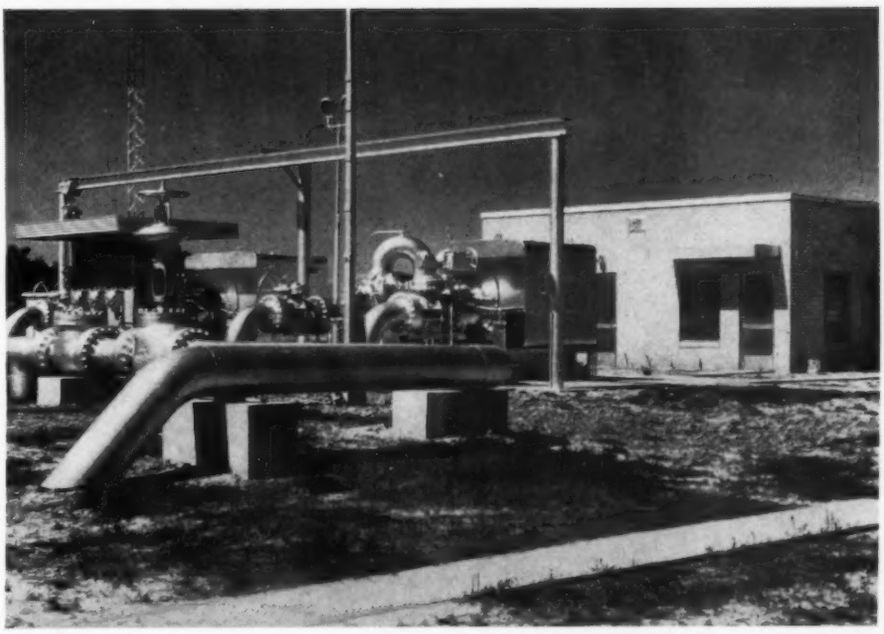
By J. R. Ashley,
Manager of Communications
and Electrical Engineering
Magnolia Pipe Line Co.
Dallas

THE FINAL STEPS in the expansion of Magnolia Pipe Line Company's Corsicana-Beaumont pipe line system was the construction of intermediate stations at Grapeland and Bragg. These stations raised the capacity of the 20-inch, 204-mile-long line to about 204,000 barrels of oil per day, the economic limit of the system.

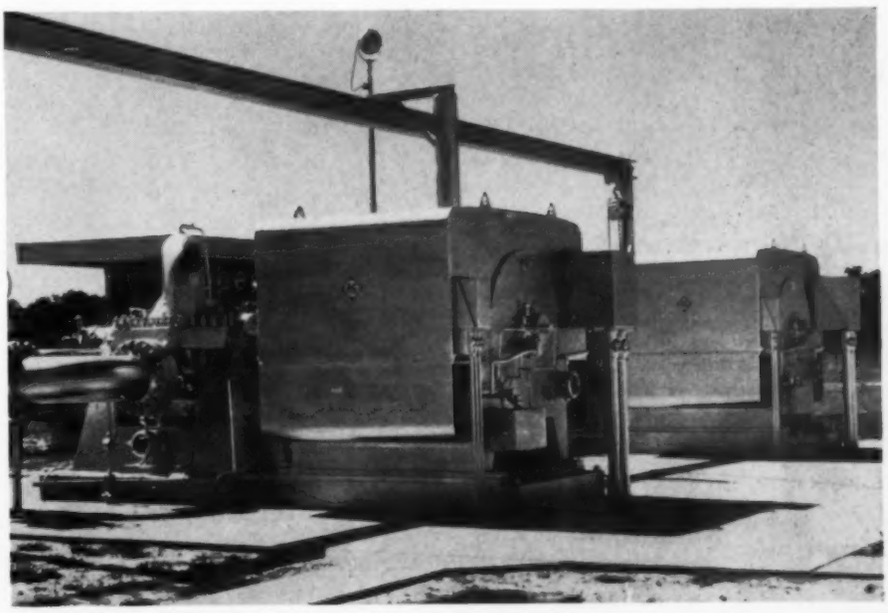
Features of the stations which materially enhanced the economic picture are:

- The stations are designed for remote control. They can be operated from Corsicana, completely unattended if necessary.
- The stations are designed to operate with suction and discharge valves wide open. This effects a sizable saving in power costs.
- The controls were greatly simplified for such an installation. Involved sequential controls were eliminated; a pump can be started or stopped regardless of whether or not other pumps are running.

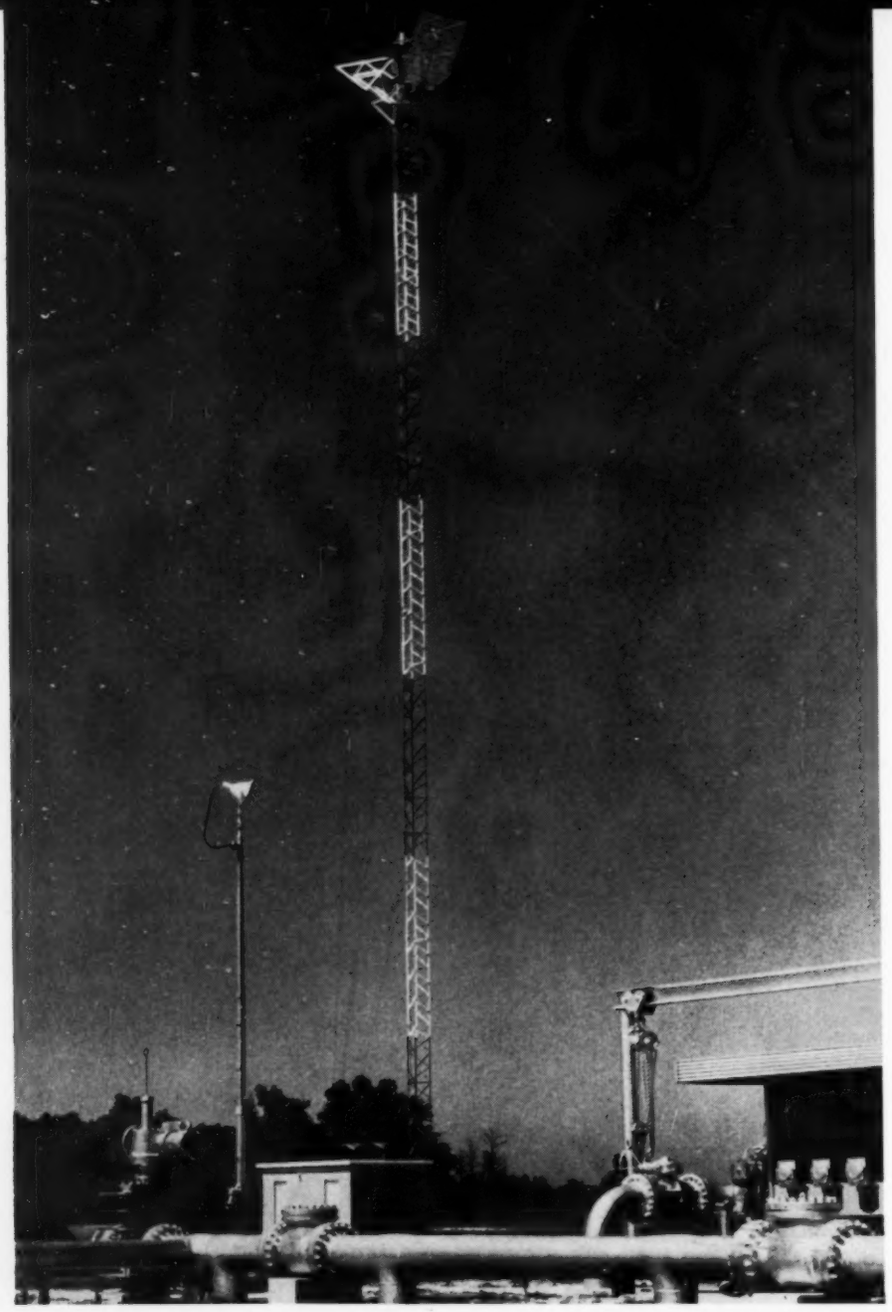
Background. Magnolia's Corsicana-Beaumont pipe line system started as a 240-mile, 8-inch pipe line with seven



Over-all view of the remotely controlled Grapeland station from the discharge side. Pressure control valve at left center is normally wide open. The two motors are 2500 hp each.



Close-up of pump and motors at Grapeland station. Power source at the right of each motor consists of two 4-inch conduits each with three 500,000 circular mils 5 kv cables.



Bragg station microwave tower and building. Both this station and the Grapeland station are operated remotely from Corsicana. The motor-operated valve, lower left, is one of three in the station piping.

oil engine-driven stations with plunger type pumps. Over the years as the demand increased, this single line became two, then three and finally the fourth, a 10-inch line, was added. With each line, additional pumps were required. This multiple line system served our requirements until a few years ago and it too was outgrown. This was the beginning of our present system.

The new Corsicana-Beaumont pipe line comprised 204 miles of 20-inch pipe with three centrifugal pumps at Corsicana station, each of which was driven by a 1,500-hp, 3,600-rpm, open drip-proof, 2,300-volt motor. One of these was a spare. With two units in operation, the line capacity was 136,000 barrels per day. The first expansion of this system was the installation of booster pumps at the approximate hydraulic mid-point of the pipe line. This was our Groveton station. Its two 1,500-hp motor-driven centrifugal pumps increased the line capacity to 175,000 bpd with all three pumps being used at Corsicana and with a line pressure of 1,050 pounds per square inch at Corsicana and 950 psi at Groveton.

Time caught up with us again and last year a further increase was necessary. This time the capacity of the line was increased to its present 240,000 bpd. This expansion required the complete rebuilding of many of the existing station facilities, together with the addition of two new stations.

Modifications to the Corsicana station can be summarized as follows:

1. Replaced three 1,500-hp motors with 2,000-hp motors.
2. Installed new high-capacity impellers in existing pumps.
3. Added one 2,000-hp motor and centrifugal pump to provide one spare unit.
4. Installed four remotely controlled booster pumps and rebuilt the mixing station in the Corsicana tank farm with a total added power requirement of 1,000 hp.
5. Replaced all existing remote control, telemetering and station operating panels.

Remodeling the Groveton station was considerably more complex. Here are the highlights of this expansion.

1. Completely replaced all unit piping and installed two new 12-inch, 2-stage, double suction, double-volute centrifugal pumps with sleeve bearings and combination flood and oil ring lubrication, 1,370 feet head at 7,590 gpm, 89 percent efficiency at 55 feet NPSH. Gravity .79 to .85 and with bearing case temperature shutdown devices.
2. Replaced two 1,500-hp outdoor weather-protected motors with two 2,500-hp, 2,300-volt, 540-ampere, 2-pole, outdoor weather-protected motors with bearing and stator temperature devices, combination ring-oiled and flood-lubricated sleeve bearings, 96.6 percent efficiency, 90.5 percent power-factor, 121 percent blocked rotor torque, 554 percent starting current, Class A insulation, 50° C rise, slip 15 rpm for a speed full load of 3,585 rpm. These motors are equipped with air filters and with 3,000 watt downtime heaters.
3. Completely replaced the outdoor control center. The new center is composed of four outdoor cubicles and houses the following equipment:
   A. The auxiliary power and lighting cubicle in which is located: 2—15 KVA and 1—25 KVA, 2,400, 120/240 volt station service transformers for 3-phase, 240-volt auxiliary power and 3-wire, 120/240 volt station lighting, and one 10 KVA control power transformer for AC closing of breakers and for space heaters and lighting in all cubicles. The 2,400-volt service to all transformers is tapped on the

line side of incoming breaker and is fed through current limiting fuses in drawout construction. The meriting potential transformers of drawout construction and station lighting and auxiliary power control panels are also in this cubicle.

B. The incoming line cubicle houses the 2,000-ampere, 4,160-volt, 150,000-KVA interrupting capacity drawout air circuit breaker, 240-volt, AC close, 48-volt DC trip. Metering consists of: ammeter and voltmeter with transfer switches, indicating watt-hour, watt-hour meter and 3 relays, long time overcurrent drawout type.

Incoming service consists of 4 parallel circuits each consisting of 3—500,000 circular mils, 5,000-volt, single conductor cables in 4-inch conduit.

This breaker is operable only from the cubicle and is tripped only by the malfunction to be described later.

C. The motor starting cubicles house 1,200-amp, 4,160-volt, 150,000-KVA interrupting capacity air circuit breakers, drawout type 240-volt, AC close, 48-volt DC trip. Main bus is 2,000 ampere and motor feeders consist of two sets of three 500,000 circular mils, 5,000-volt, V.C.I. single conductor cables, each set of three in a 4-inch conduit. Each starter is equipped with: ammeter and transfer switch, current balance relay, undervoltage relay, 2-element thermal relay and three long-time overcurrent relays. The control for the motor starters is three position: at the cubicle, from the station control panel in the office or by remote supervisory control.

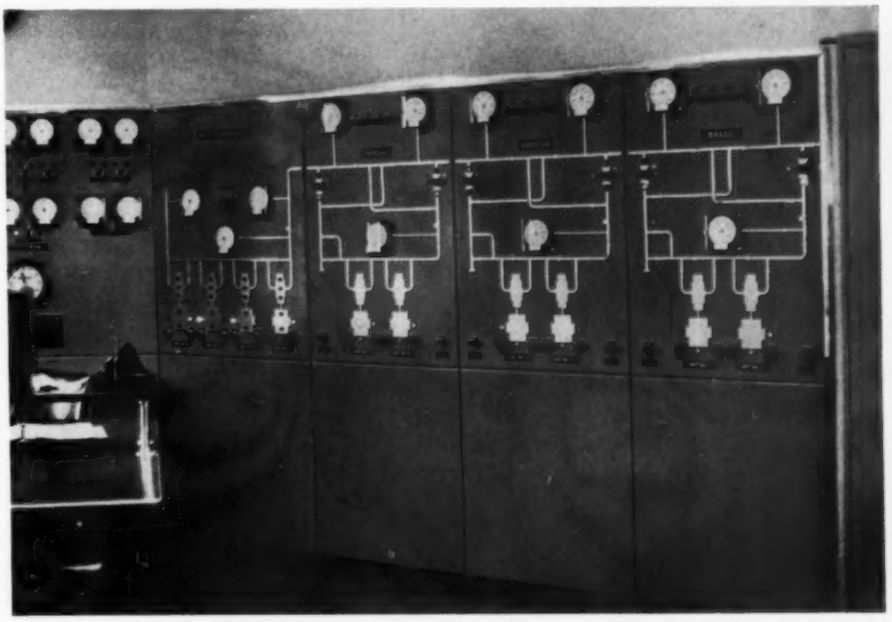
4. Replaced all supervisory control and telemetering equipment at Corsicana and Groveton.

GRAPELAND AND BRAGG STATIONS

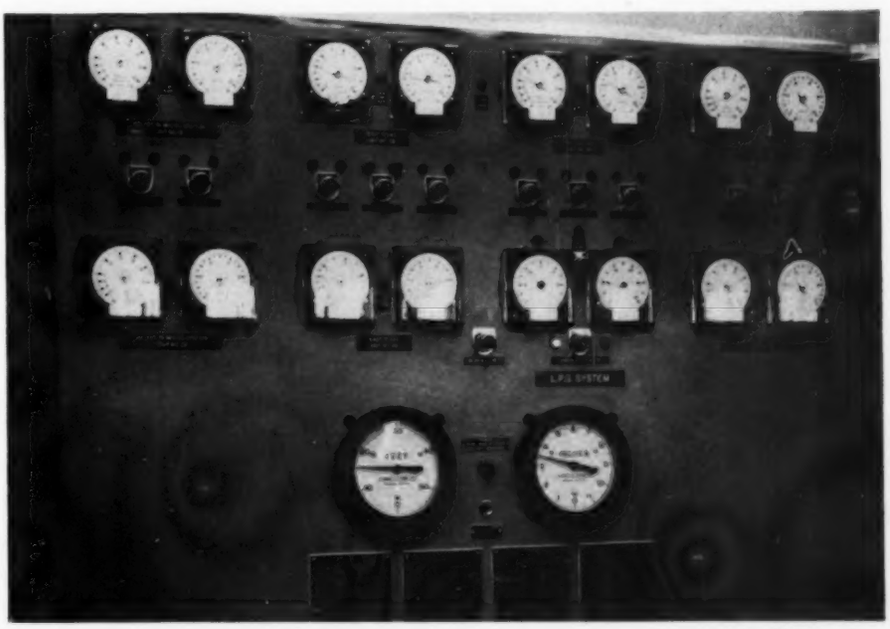
These are the two new stations which were added. Grapeland is between Corsicana and Groveton. Bragg is between Groveton and Beaumont. Each of these stations has two 2,500-hp pumping units and is electrically and mechanically a duplicate of Groveton station.

These intermediate or booster stations are remotely controlled over a new microwave system from Corsicana. They are designed for complete unattended operation, however, we have a resident station engineer on duty a normal five-day week. In case of emergency, he is on call at any time.

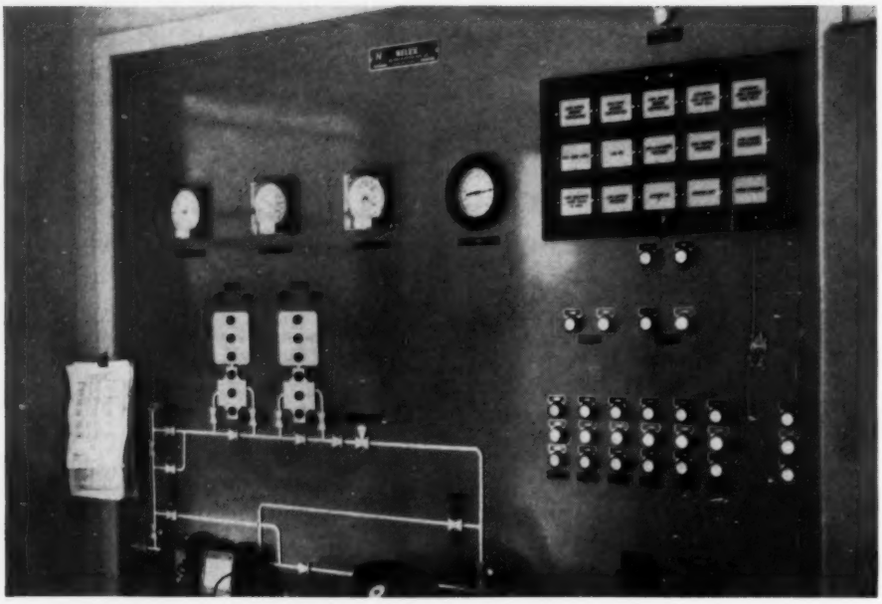
The primary design of these stations is based on "fail safe" operation with full provision made for maintaining "status quo" conditions in the event of failure of the communications link or supervisory control to Corsicana. In order to accomplish these objectives, consideration must be given to individual unit, station



Control panel at Corsicana station for the Corsicana-Beaumont system. At the extreme left is a part of the tank farm control panel; next is the Corsicana Station control showing mimic station piping and gages for suction, control and discharge pressure. The indicating lights in the center of the pump mimics indicate high bearing and pump case temperatures; those in the motor indicate high bearing and stator temperature. The light to the left of the motor indicates a running motor and to the right a "down" motor. The push buttons below the lights are "Start" and "Stop." Following from left to right are the supervisory control panels for Grapeland, Groveton and Bragg stations. Each station has its own separate control and a failure of channel or supervisory to one station affects only that station.



Corsicana tank farm control panel with suction booster pump controls, suction and discharge pressure gages for each pump. At right center is the remote control and telemetering for the LPG station. Bottom center is the remote gaging equipment for the tank farm.



Grapeland station control panel with station mimic, remote pressure gages, air pressure gage, 15 function annunciator, local control pushbuttons and two transfer switches. The latter make it possible to switch from remote to supervisory control and to transfer various devices from normal to test position without shutting down station.

Grapeland gage board showing temperature and pressure protective devices, pressure gages and controls.

and line protection. To give protection to the individual units, differentiation has been made between malfunctions which will shut down but permit remote restarting and those which will shut down and lock out.

The following protective devices will shut down either or both units but will permit remote re-starting upon return to normal:

1. Power failure
2. Low suction pressure
3. High discharge pressure
4. High control pressure

Station Control Valve. Here I would like to explain the operation of the station pressure control valve. This is an air actuated control valve, located in the station loop on the downstream, or discharge side of the station. Its sensing devices "look" at both the station suction and line discharge pressures. It protects the pumps against loss of suction and the line against high pressure. Suction pressure control is the overriding function. As the suction pressure tends to drop below control set-point, the valve will close and thus reduce the flow and raise the suction pressure. The same thing happens if the discharge pressure tries to increase above the set-point.

Shutdown Controls. In case the control valve cannot correct these faults, the protective devices operate and the station is shut down.

The following malfunctions shut the individual units down but will permit remote re-starting upon return to normal:

1. Current unbalance
2. Time over-current
3. Thermal overload
4. Instantaneous short circuit
5. Stator temperature
6. Incomplete sequence or failure of pump discharge valve to open
7. Power failure

Further unit protection shuts the units down and prevents re-starting until manually re-set at the station, these are:

1. Motor bearing temperature
2. Pump bearing temperature
3. Pump case temperature

There are four malfunctions which lock the station out, close the loop suction and discharge valves and prevent remote re-starting until corrected.

1. Loss of control air
2. High sump level
3. Excess seal leak
4. Local emergency stop

When any of these occur whether the station is operating or not, the incoming line breaker is tripped. It is operable only locally and only at the cubicle. Auxiliary switches on this breaker are interlocked with the station loop valves. When the incoming line breaker is opened for any reason, the station loop valves close and isolate the station. These malfunctions indicate other serious mechanical failures. The loss of air closes the control valve and blocks the station discharge. High sump level can be caused either by failure of or drainage beyond the capacity of the sump pump. Excess seal leak is indicative of pump shaft seal failure or in rare cases a stopped drain line.

Seal failure is detected two ways. The external seal chamber is closed and a blow-out is detected by pressure devices. In addition a metering type of device is actuated by flow if excess of normal quantities passes by an orifice.

Simplicity of Design. The design of the stations has been kept as simple as possible for optimum service. Each unit is operated with its suction valve

open. Its motor operated discharge valve is interlocked with the unit motor starter. Timing on the valve opening allows sufficient time for the unit to come up to speed before fluid begins to pass. An incomplete sequence relay takes the motor off the line if the valve does not open to about 50 percent in approximately 35 seconds. All operations of protective devices are indicated on an annunciator on the local control panel.

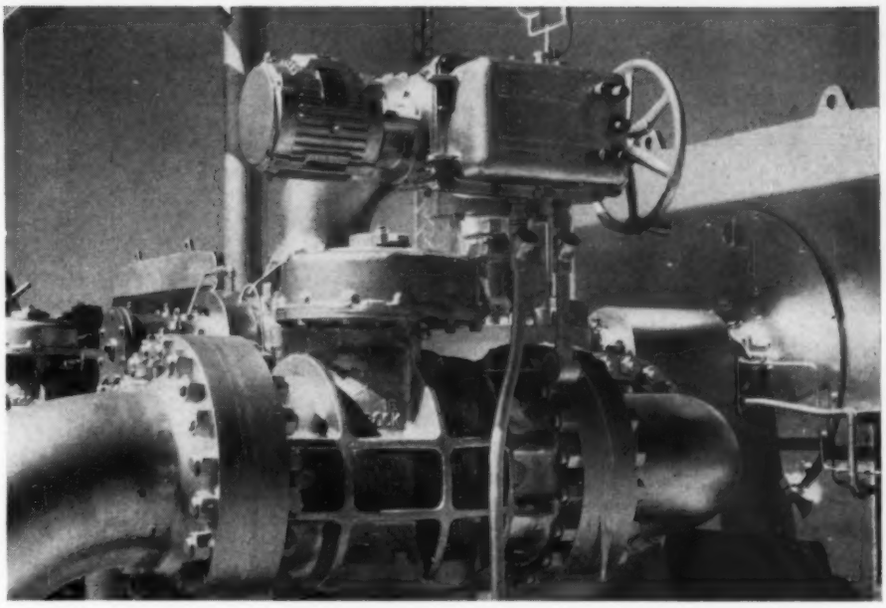
Supervisory control functions and telemetering have also been held to the minimum. The remote control functions for each station are:

1. Open-Stop-Close on station suction and discharge valves with remote indication of open, intermediate and closed positions.
2. Start and Stop on each unit with remote indication of unit status.
3. Four alarm functions are transmitted to Corsicana. They are: "Uncalled for" operation, failure of supervisory control channel, power failure and station lockout.

Only three pressures are telemetered to Corsicana from each of the stations: Suction, Control and Discharge pressure, and these are continuous with visual gage read-out.

Careful consideration had to be given to the selection and application of the station sensing devices. As an example, let us take suction pressure. With only Corsicana pumping into the line it can operate at 1,050 psi pressure. Grapeland pressure may then be between 700 and 800 psi while the Bragg pressure may range from 250 to 300 psi. Suction protective devices have to withstand these pressures and yet be sensitive to only a few pounds when the station is in operation.

All normal line operations are directed by orders from the dispatcher in Dallas. The instructions will include the time the unit or units are to be started, the kind or grade of crude to be pumped and under certain conditions of delivery, the Corsicana discharge pressure may be given in general terms; such as, not to exceed 850 psi. This line has a high diversity factor and by operating various combinations of units and stations, many different thruputs can be maintained. These quantities are set in advance and are scheduled on a monthly basis with a constant daily thruput.



Close-up of 16-inch motor-operated valve showing integrally mounted control.

Savings. We make every effort possible to hold our demands to a minimum and our load-factors to the maximum. In other words, we try to operate each station as economically as possible. It is for this reason we have asked that power bills be based on calendar months.

Hydraulic Characteristics. When the line was first placed in operation, experimentation was carried out to determine its actual hydraulic characteristics. We found that these values differed from those we had calculated. For example, we carefully studied the speed-torque curves of the motors and those of the pumps. Oscillograph records of motor operation in the original Groveton station were studied and all other information was used.

All of this indicated the new stations could be operated with unit suction and discharge valves open. There are certain advantages to this method of operation. Among them are: a saving of several thousand dollars, elimination of sequence operation with additional trouble points and the ability to start or stop either pump without regard to the status of the other. Otherwise with the upstream pump in operation and the down-stream one is to be added, in order to prevent excessive casing pressure, it is necessary to first shut down the running unit.

With all of our calculations the hydraulics of the pipe line and pump combination were such that speed-torque curves crossed and it was necessary to add sequence control and start each pump against a closed discharge valve. This reduced the motor torque requirement and permitted the unit to come up to speed in approximately nine seconds. As far as motor currents are concerned, this made no difference except in duration. In these motors there is little delay from blocked rotor currents until acceleration to approximately 75 percent speed, the drop then is very rapid as pull-in torque brings the motor up to speed.

ACKNOWLEDGMENT

From a paper presented at the 1959 conference of the Petroleum Electric Power Association, Galveston, Texas.

About the Author

J. R. Ashley was graduated from Virginia Military Institute with a B.S. degree in electrical engineering in 1921. He joined Magnolia Pipe Line Company in 1927 after serving with Texas Power & Light Company and General Electric Company. At Magnolia, Ashley served in numerous construction and maintenance positions and was promoted to manager, Communications and Electrical Department in 1958. He is a member of the AIEE and PIEA.

Fuel Cells Power Tractor!

From the laboratory comes the first practical application of a new source of power

A NEW SOURCE of electrical power has been harnessed to pull a farm tractor. After several years of experimental work on the part of many companies, one company has produced the first practical, wheel-turning fuel cell assembly.

This new source of power is the most efficient means yet devised for converting chemical energy to electrical energy. In it, a mixture of gases—largely propane—is fed into the anode electrode of the cell and oxygen is fed into the cathode electrode. Reactions take place which produce a direct current as well as water and carbon dioxide.

Under the hood of the tractor, 1,008 of these cells linked together produced enough electricity to provide the tractor with 3,000 pounds of drawbar pull. This is sufficient to pull a multiple-bottom plow through hard, dry farm land.

A director of research and vice president of the manufacturing company pointed out that the tractor is a research vehicle, despite the fact that it is of commercial size. "However," he added, "fuel cells of the future may provide electric power for homes and factories, for vehicles such as trucks and buses . . ."

The cells in the tractor measure ¼-inch thick and 12 inches square. They are joined in 112 units of nine cells each. These 112 units are arranged in four banks, and electricity can be taken from any combination of the banks.

How the Cells Work. The propane and other gases are fed into the cells through a system of tubing, and once in the cells, the gases react in an electrolyte. A catalyst coating the electrodes in each cell aids the reaction. This reaction with propane releases a stream of electrons—direct current—to the external circuit. Meantime at the cathode electrodes, oxygen is adsorbed, and with the aid of an electron from the external circuit it reacts with the electrolyte, thus reforming the ion which was used up at the anode electrode.

The current flow is directed through a bus bar to a standard controller. This regulates the electricity supplied to a standard 20-hp DC electric motor, regulating the speed and direction of motor rotation. Using the speed control, the operator places the four banks of cells in series or in parallel, varying the amount of current going to the motor.

The tractor carries its gas supply in tanks mounted in brackets on the vehicle.

As a device which provides direct current power, the fuel cell resembles other electric cells but has a considerably higher efficiency. Like all batteries, it consists essentially of electrodes and electrolyte. Conventional storage cells, however, have their energy stored in the electrode-

A mixture of fuel gases—largely propane—and oxygen react in an electrolyte within 1,008 individual fuel cells to provide electricity that powers this experimental tractor. The compact controller to the left of the driver controls the "engineless" tractor's speed, and can reverse its direction. The fuel cell tractor develops 3,000 pounds of drawbar pull—more than enough to pull a multiple-bottom plow in field tests.

electrolyte system within the cell, whereas the fuel cell can store no energy within the cell itself. It instantaneously converts chemical energy to electric energy. A fuel, such as hydrogen, supplied from an external source can furnish this chemical energy. In theory, a fuel cell can supply electric power as long as the fuel supply lasts. In the past, fuel cell performance left much to be desired because of the difficulties associated chiefly with unfavorable chemical reaction rates.

What was probably the first fuel cell was described by Sir William Grove in 1839. The cell operated on hydrogen and oxygen. Fifty years later, in 1889, particularly good results were reported by Ludwig Mond and Charles Langer, who obtained a relatively high current density of six amperes per square foot with essentially the same type cell. In 1921, Professor E. K. Rideal discussed "The Problem of the Fuel Cell" before The Faraday Society. A few of the more recent fuel cell investigators include O. K. Davtyan in Russia (1946), F. T. Bacon in England (1935 to the present) as well as scientists of several other companies in the United States. Several types of fuel cells are being investigated. Among these are direct fuel cells utilizing solid fuel, semidirect cells which utilize gaseous fuel, and indirect cells utilizing an oxidation-reduction (redox) system.

Future Potentialities. Engineers see in the fuel cell a valuable energy conversion method through use of off-peak generator facilities to produce hydrogen and oxygen which can be stored, transported and utilized at will in fuel cells. Low voltage constant loads of such electrochemical processes as plating, water purification, galvanizing, electrolytic cleaning and electrolytic refining of metals could make use of this type of energy.

When the free energy of the reaction is converted directly into electric energy, as is the case in the fuel cell there is no theoretical limitation on efficiency. The possibility of producing electric power directly from a fuel at an efficiency of 90 percent is truly startling when compared to the best diesel engines, which are about 40 percent efficient. Because the fuel cell does not involve heat but converts chemical energy directly into electric energy, it escapes the high heat engine energy losses. —**The End**

The tractor in action. The 1,008 fuel cells arranged in 112 units of nine cells each are producing 15 kilowatts of electricity. Although the tractor is of commercial size it is still a research vehicle.

Close-up of the controller which controls the speed and direction of the tractor.

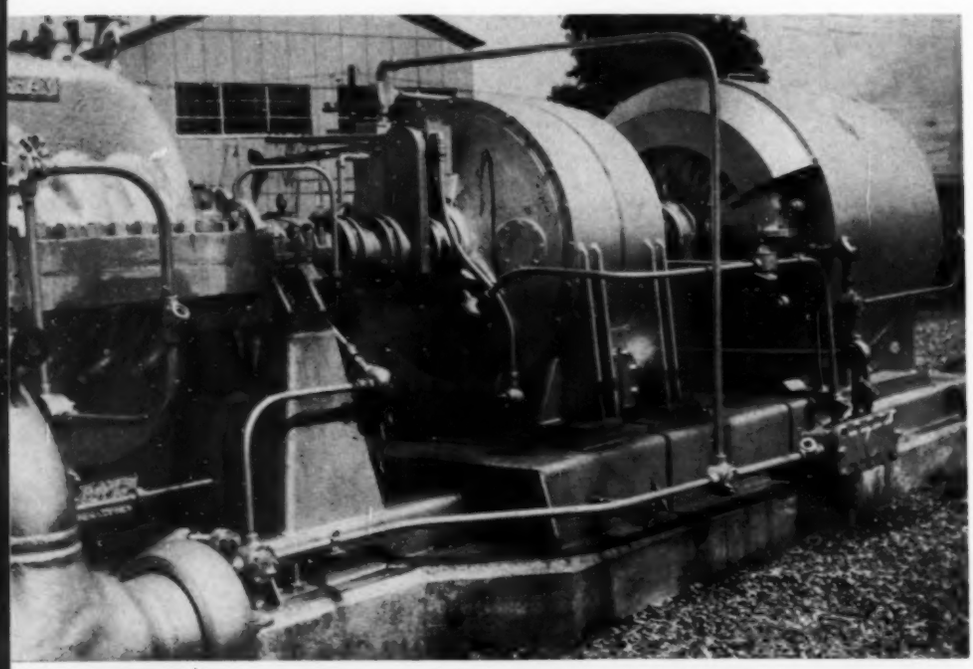
Eddy-Current Coupling Saves Power, Improves Efficiency of Stations

This device, accepted in other industries, is producing surprising results in controlling electric-centrifugal pump stations

By E. C. Michels, Chief Engineer, Continental Pipe Line Company
Ponca City, Okla.

ONE MEANS of combating rising costs is to carefully search other industries for ideas and new equipment which may improve efficiency and provide economies. A case in point is the variable speed drive which is based on the eddy-current principle. Long used in the power industry to control the output of boiler feed-water pumps, it is now proving highly efficient in controlling electric-centrifugal pump stations.

The head-capacity characteristics of a constant speed electric-driven centrifugal pump can be designed to meet a limited number of operating conditions on any given petroleum pipe line handling multiple products. The various and continually changing operating conditions depend upon the thruput needs and the physical characteristics of each product. It is therefore necessary to provide a method of control so that, within a preset range of suction and discharge pressures and power consumption limits, a maximum number of operating conditions will be met.



Eddy-current coupling links electric motor and centrifugal pump. The advantages of this piece of equipment are exciting pipeliners. It is saving power and increasing station efficiency on products lines.

The throttle valve is an accepted method to control the pump output. The variable speed drive, which can also be used for controlling the pump unit, will provide a more flexible operation and reduce the power costs.

The eddy-current principle is utilized in the variable speed drives installed on the Products Division of Cherokee Pipe Line Company's system to Wood River, Ill. Single electric-driven pump units were installed on each of the two 10-inch lines at the five booster stations located between Glenn Pool, Oklahoma, and Wood River, Ill., as shown in Figure 1. These pump stations, which are remotely controlled from Wood River, have been operating since September 1958.

It can be shown how an eddy-current drive, which lends itself to the operation, will pay out the additional investment cost compared with throttling through power savings; furthermore, by using electric demand controllers, additional thruput is obtained for any given power setting.

How an Eddy Coupling Works. The eddy-current drive transmits the rotation from the constant speed electric motor to the centrifugal pump. The coupling consists basically of three members: The stationary member or *field assembly,* the driving member or *drum,* and the driven member or *rotor.*

The field assembly has a field coil enclosed in a field housing which, to-

gether with the end bells, form the stator or housing of the drive unit. The field housings are separated on the inner surface of the field assembly by a metal magnetic barrier to form the north and south polar rings of the field assembly. Because the field assembly is stationary, the excitation current is conducted to the coil directly through the field coil leads.

The drum or driven member revolves within the field assembly with the outer surface of the drum separated from the polar rings of the field housings by an air gap. The drum is divided into two cylindrical sections by a metal magnetic barrier. Each section assumes the polarity of the adjacent polar ring when the field coil is excited.

The rotor with poles similar to the teeth of a spur gear revolves inside the drum. An air gap separates the tips of the rotor poles from the inner surface of the drum. As current is applied to the field coil, magnetic lines of force flow from the north polar rings of the field and drum sections to the rotor poles and from the rotor poles to the south polar rings of the field section. These lines of force converge at the drum's inner surface as they flow into the rotor poles, causing areas of high flux density as shown in Figure 2.

As the rotor revolves in relation to the drum, the flux density at any given point on the drum's inner surface varies as that point is passed alternately by the poles and grooves of the rotor. This flux variation generates eddy-currents in the inner surface of the rotor and establishes a magnetic field with polarity opposite to that of the field established by the driving field coil. Torque is transmitted from the drum to the rotor by a magnetic attraction between the eddy-current field in the drum and the poles of the rotor.

The strength of the eddy-current field varies with the rate of flux variation and with the amplitude and frequency of the variation. Amplitude is determined by the field coil strength or excitation current, while frequency is a function of the "slip," or difference in the speeds of the drum and rotor. At a given field strength, with load conditions constant, the slip between the drum and rotor will remain relatively constant at the frequency required to develop an eddy-current field of sufficient intensity to transmit the required torque As the excitation current is increased, the slip is reduced, since the amplitude of flux variation is greater and the speed of the rotor will approach the speed of the drum. Speed control of the coupling is obtained with a control system that adjusts the field coil amperage to deliver the required torque at the desired speed.

A tachometer generator on the driven member of the unit produces

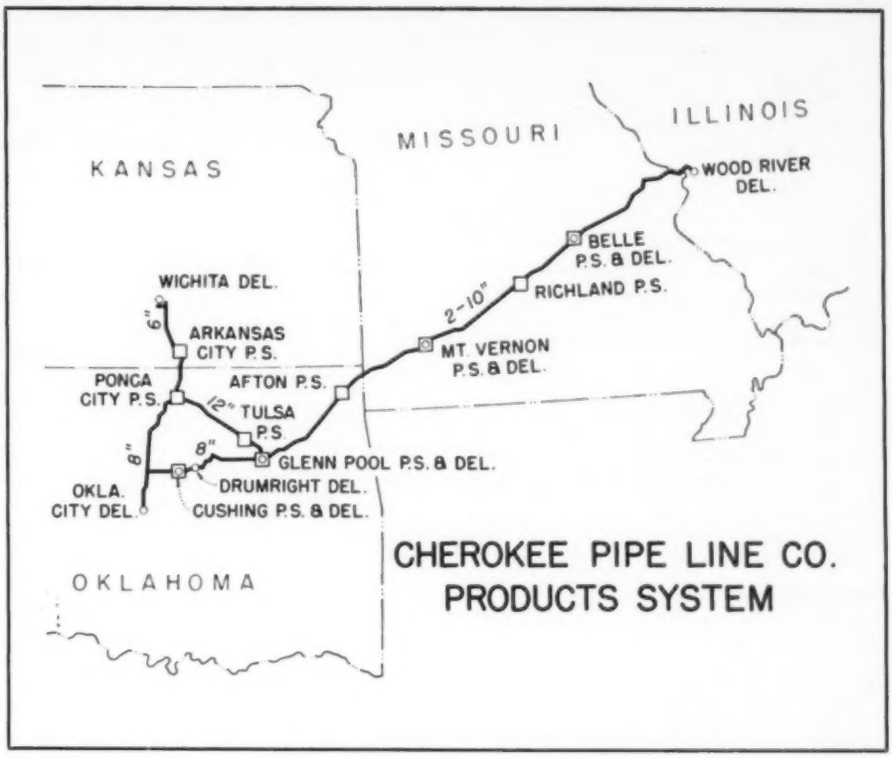
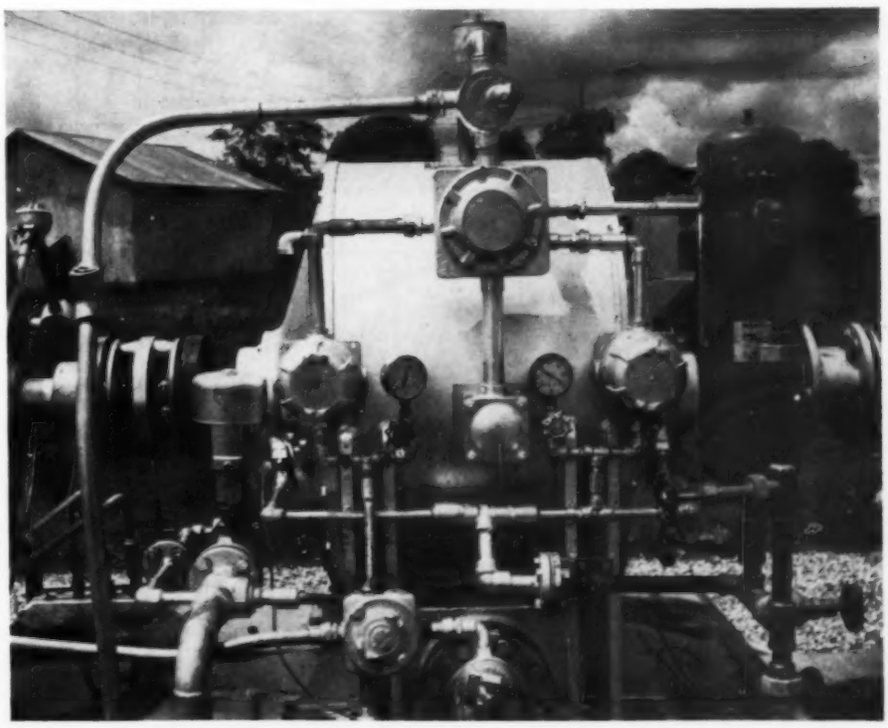


FIGURE 1—The eddy-current principle is utilized in the variable speed drives installed at the five booster stations located between Glenn Pool and Wood River. The stations are remotely controlled.



Close-up of the eddy-current variable speed drive. It transmits torque from the motor-driven drum to the rotor which drives the pump, by the magnetic attraction between the eddy-current field in the drum and the poles of the rotor.

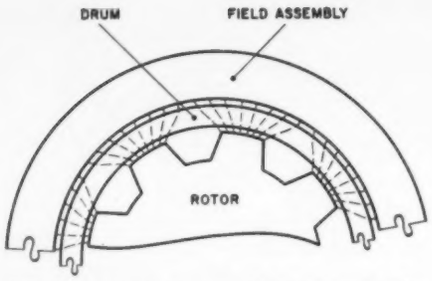


FIGURE 2—How the eddy-current drive works. The flux pattern of the stationary field coupling acts between drum and rotor.

a voltage in direct proportion to the speed at which it is driven. This voltage is utilized in the governing circuit of the electronic control to achieve speed control of the driven member of the coupling.

Applications. Each pump station on the Cherokee System is equipped with three electronic controllers which feed signals into the governing circuit to regulate the coupling speed or output of the pump. The functions which are controlled are:

1. Low suction pressure
2. High discharge pressure
3. Station electric demand

When the preset limits of any one of these functions are exceeded, a signal from the controller to the governing unit will cause the excitation current to be reduced, thus slowing the unit down, therefore reducing the pressure and flow.

The efficiency of the eddy-current drive is in direct proportion to input and output speed. Fixed losses amounting to 2 to 4 percent also **add** to the losses due to slip in the drive; therefore at 90 percent speed, the efficiency of the drive is from 86 to 88 percent.

At Afton station, one of the units is a 600-hp, explosion-proof, 3,550-rpm, constant speed motor driving an eddy-current variable speed drive and centrifugal pump. At full speed and load, the excitation power is 1,100 watts and slip approaches 100 rpm; therefore the fixed losses amount to 1.47 hp for excitation and 16.9 slip hp, or a total fixed loss of 18.37 hp. The cooling oil pump and cooling fan require up to 6 additional hp; therefore 25 hp has been assumed as the total fixed losses in these calculations. These losses are approximately equivalent to losses expected across a fully open throttle valve.

Figure 3 shows the typical pump and line characteristics and horsepower curves for Afton station. The constant speed horsepower curves represent the motor hp required to drive the pump throughout its operating ranges for fuel oil and gasoline. The variable speed horsepower curves represent the motor hp required to meet the actual pipe line conditions plus the variable speed drive losses. The continuous horsepower curves show how the pump performs when the electric demand controller is limiting the pump speed. The pump efficiency curves are shown on Figure 4. It should be noted that, if the pump is operated at a rate less than the maximum peak efficiency rate, it is more efficient to do so by reducing speed rather than throttling the pressure at full speed.

Example. Afton station is designed to operate at 900 psi, at which pressure the fuel oil rate is 30,000 bpd and requires 588 hp at full speed with a pump efficiency of 78.5 percent. If the thruput rate is reduced to 75 percent or 22,500 bpd, the required line pressure is 625 psi. To pump this rate at full speed using a throttling valve for control, the pump will throttle back to 970 psi and require 525 hp. The pump efficiency will be 71 percent. With a variable speed drive, the pump will operate at 2,770 rpm and an efficiency of 77.5 percent. The motor load will be 405 hp.

Constant speed throttling at 22,500 bpd fuel oil rate:

$$\text{Motor hp} = \frac{22{,}500 \text{ bpd} \times 970 \text{ psi} \times 0.000017}{71 \text{ percent}} = 525 \text{ hp}$$

Variable speed drive at 22,500 bpd: (The pump discharge head is proportional to the ratio of the pump speeds squared.)

$$\frac{P_2}{P_1} = \left(\frac{S_2}{S_1}\right)^2$$

$$\text{thus } S_2 = \sqrt{\frac{630}{970}} \times 3{,}450 \text{ or } 2{,}770 \text{ rpm}$$

$$\text{Drive Efficiency} = \frac{S_2}{S_1} = \frac{2{,}790}{3{,}450} \text{ or } 80.5 \text{ percent}$$

$$\text{Motor hp} = \frac{\text{Pump bph}}{\text{drive efficiency}} + \text{fixed losses}$$

$$= \frac{22{,}500 \text{ bpd} \times 625 \text{ psi} \times 0.000017}{77.5 \text{ percent} \times 80.5 \text{ percent}} + 25 \text{ hp} = 405 \text{ hp}$$

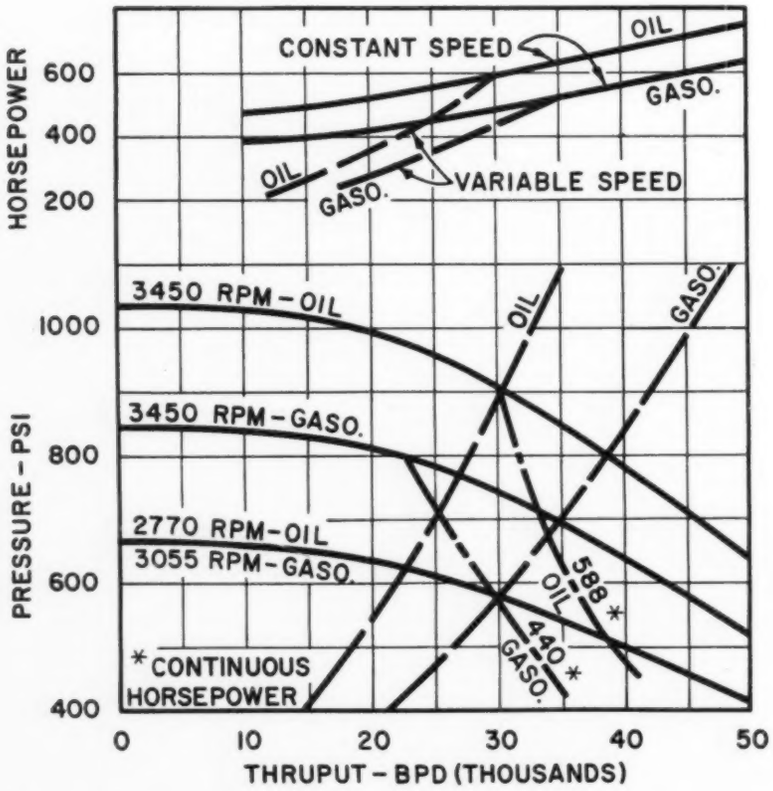


FIGURE 3—Typical pump and line characteristics and horsepower curves for the Afton station. The constant speed horsepower curves represent the motor horsepower required to drive the pump throughout its operating ranges.

Savings. A power reduction of 120 hp is realized, therefore, which, at a

cent per kw-hr. rate, will amount to a savings of $7820 per year.

Let us further assume that a setting of 440 hp is made on the electric demand controller and that the station is pumping gasoline. If the station is equipped with a throttle valve, the flow rate would be limited to 23,000 bpd. The station would be throttling from 795 psi to 435 psi. Using a variable speed drive, the pump would operate at full speed until the 23,000-bpd rate was reached. At this point the demand controller will signal for the pump to slow down to stay within the demand limit. As the pump slows down, it will operate along the 440 continuous hp curve until it reaches the gasoline line characteristic curve at the 30,000-bpd rate. An increase in capacity of 7,000 bpd is thus realized with an electric demand controller and a variable speed drive. This increase is equivalent to 20 percent of the rated gasoline capacity for the station.

The power savings shown in Figure 5 are at thruputs ranging from 50 to 100 percent rated capacity for gasoline and oil. The curves also show the equivalent capacity increase that can be realized when throttling to minimize power as compared with slowing down the pump speed.

A substantial power savings is thus realized whenever the station operates at less than full capacity. This condition will be the rule rather than the exception when handling multiple products on a system and when station controls are limited by maximum discharge pressure, minimum suction pressure, and electric demand.

Because all stations on the Cherokee System are equipped with demand controllers, the power level for the system can be optimized for a given thruput. In practice, the power meters are read on the same day of each month at all stations. As soon as the meters are read, the demand controllers are reset to meet the following month's projected thruput.

Payout. The schematic diagrams in Figure 6 shows that the cost of the variable speed drive exceeds that of a throttle control valve installation. The difference of $7,880 is estimated for the unit at Afton station. Using an income tax rate of 50 percent, the power savings for various thruputs will pay out the additional investment as shown in the following table:

Rated Capacity	PAYOUT—YEARS	
	Fuel Oil	Gasoline
60%	1.3	1.8
70%	1.7	2.4
80%	2.4	3.5
90%	4.5	6.8

Based on the operation experience thus far, the additional cost of the drives is expected to pay out in less than 3.5 years.

Other Advantages. In addition to these savings, other tangible benefits are also realized. The speed control signals are transmitted electrically, and the response action of the drive is immediate. If, for instance, the station is operating at or near the suction control point and the next up-

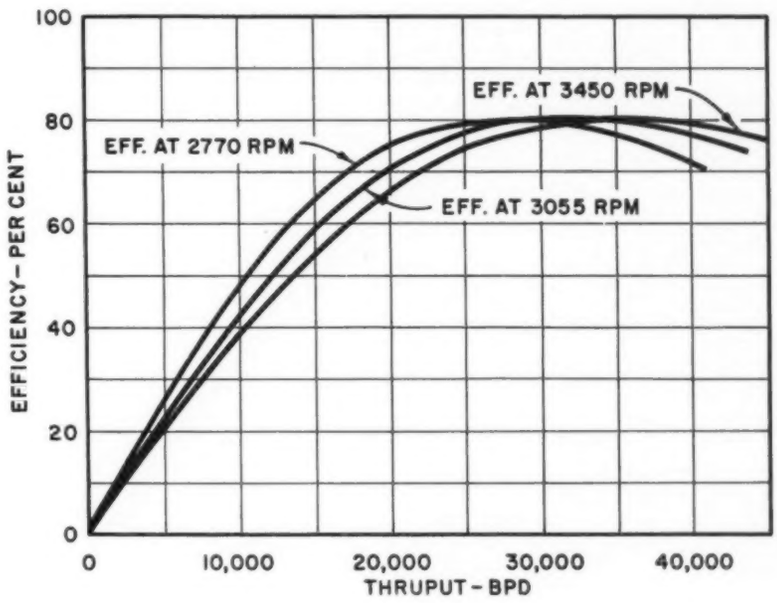


FIGURE 4—Pump efficiency curves for the Afton station. Note that if the pump is operated at less than the maximum peak efficiency rate, it is more efficient to reduce speed rather than throttle.

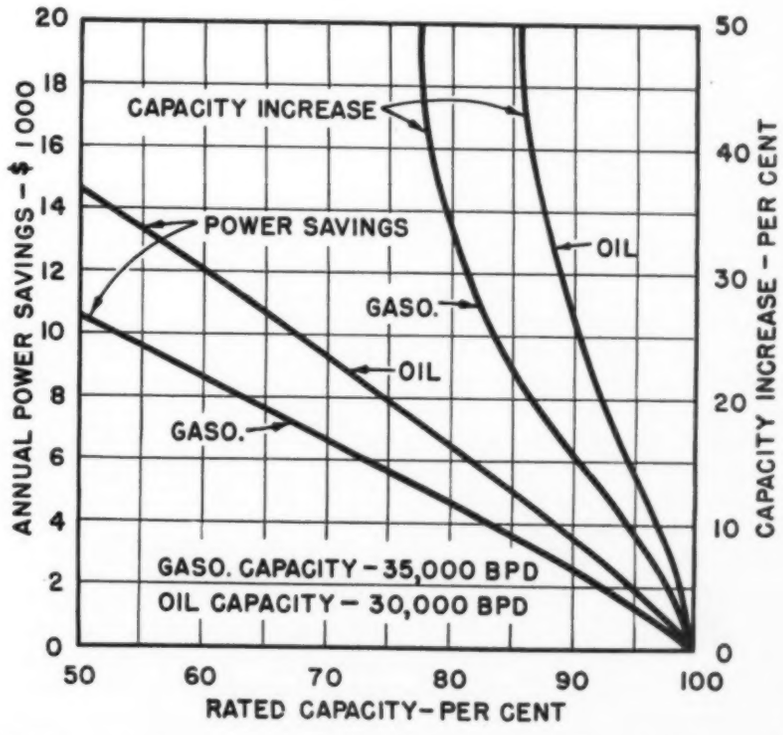
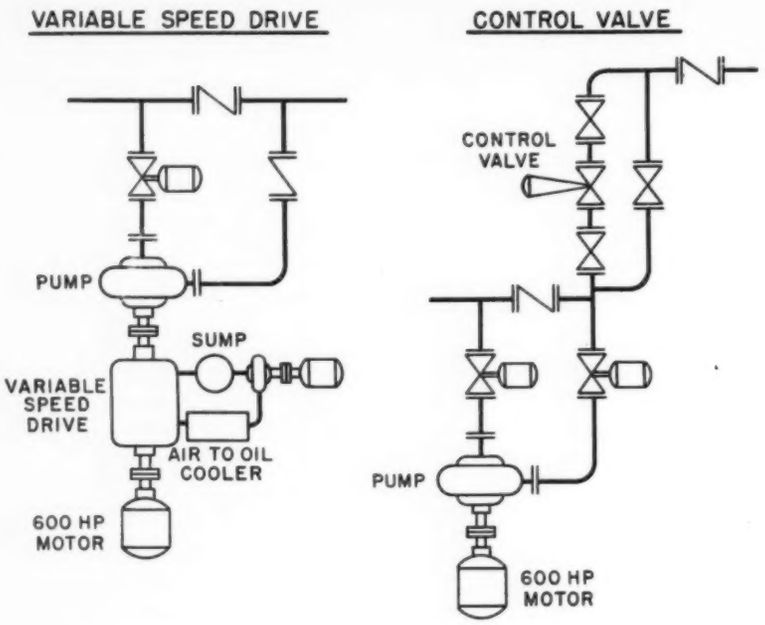


FIGURE 5—Advantages of the couplings. Power savings and equivalent capacity increase of the variable speed drive as compared with throttling valve.



INSTALLED COSTS (EXCLUDING PUMP & MOTOR)

	VARIABLE SPEED DRIVE	CONTROL VALVE
MATERIALS	$21,500	$14,570
CONSTRUCTION	2,750	1,800
	$24,250	$16,370

DIFFERENCE $7,880

FIGURE 6—Schematic diagram showing variable speed drive and control valve set-up for station. Note the difference in cost. Payout from power savings runs 3.5 years.

stream station is suddenly shut down because of power failure or otherwise, the sudden drop in station suction pressure is immediately sensed by the electronic pressure transmitters. The electronic station suction controller receives the pressure signals simultaneously; and when the pressure reaches the set-point limit, the controller immediately calls for reduction in pump speed.

The station is equipped with a low suction shutdown switch set a few pounds below the suction controller. The response action of the drive is such that it will slow the pump down before the low-suction switch can be tripped. The same reaction occurs if the station were operating at or near the high discharge control point. Should the next downstream station suddenly shut down and in turn cause a rapid pressure rise at the station, the drive and pump will slow down in time to prevent the high discharge pressure switch from shutting the station down; therefore the drives will reduce the effects of and minimize the occurrence of line surges due to a station suddenly shutting down. Although the stations will shut down suddenly because of power and/or equipment failures, these occasions are not too frequent as compared with the number of shutdowns caused automatically to permit passage of scrapers by the stations.

The start-up sequence of the drive unit also lends itself to a smoother operation. The station will not start unless the drive is at zero speed condition, which it automatically adjusts itself to whenever the station is shut down. When the start sequence is initiated either locally or remotely, the suction valve opens; and when fully open, the motor will start. The speed governor control will then cause the drive to come up to speed by increasing the excitation current. The drive will accelerate, the rate of which is adjustable, until the set values on any of the station controls are reached. The drive will then accelerate at a rate such that the control limits are not exceeded.

It should be pointed out that it is common practice to use a positive shut-off discharge valve on stations controlled with a throttle valve to minimize motor loads and transmission line voltage drops during start-up. The variable speed drive starts with the pump disengaged; therefore the starting load is less, which will materially lengthen the life of the motor. A check valve will adequately suffice for the discharge valve of the unit, thus reducing the number of valve operators and controls normally required at automatic stations; also the shut-in or case pressure of the pump will never exceed the operating pressure. A longer life is therefore expected on pump seals, wear rings, and impellers.

Overall-Benefits. During the past year of operation, the following advantages have been realized by using eddy-current variable speed drives on the Cherokee System.

1. Power savings will pay out the additional investment cost over throttling valves in less than 3.5 years.
2. Electric demand controllers used in conjunction with the drives will permit a more complete range of operations and result in increased capacities for given power settings.
3. It smooths out the line operating conditions and effectively reduces the maintenance of pump and motor equipment.

ACKNOWLEDGMENT

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About the Author

E. C. Michels started to work in 1950 for Continental Pipe Line Company as an engineer. In 1952 he became superintendent of Pioneer Pipe Line Company with headquarters in Salt Lake City and in 1954 moved to Ponca City and later to Wood River, Ill., as Superintendent of the Cherokee Pipe Line Company. At that time he was in charge of construction and operation of the products division. Michels returned to Ponca City in 1956 as chief engineer of Continental Pipe Line Company.

What's New in Telemetering

From the aircraft and missile industries comes new "hardware"

By B. C. Joyce, Applications Engineer
The Bristol Company
Waterbury, Conn.

IN THE PAST few years, the use of telemetering has grown tremendously in the gas industry, and the need for new techniques is now apparent. Specifically, there is a need for faster speed of response, greater utilization of transmission facilities and the need to share these facilities with control functions.

New types of telemetering systems which have recently been made available for use in the gas industry may supply some of the answers. These new systems have been "borrowed" from the aircraft and missile industries which have used high-speed telemetering for years on development of military products. In general, this equipment has been expensive, but because of other economic factors, the cost has been justified. As a result it is well for any company intending to use telemetering to analyze the various aspects of these new types of telemetering systems to see how they might fit in with any proposed expansion.

Any telemetering system can be divided into three parts. These are: the transmitting terminal, the interconnecting means, and the receiving terminal. Normally, the equipment that is supplied for the transmitter and receiving terminals is considered the telemetering hardware, but because a chain is no stronger than its weakest link, let's first discuss the method of interconnection before proceeding with the description of new types of telemetering systems.

INTERCONNECTING MEANS

The simplest form of interconnection between the transmitting and receiving terminals would be two metallic conductors. Because the separation between the transmitter and receiver is usually quite lengthy, these conductors are normally leased from the telephone company which is set up to install, maintain, and service these facilities.

Leased Facilities. The telephone company makes available several classes of service, starting with a circuit for use on DC pulses (under 15 cps) and progressing to radio and television channels which may have a band-pass of several thousand cycles. In the latter category, we are generally interested in circuits that will pass audio carrier tones, because these permit many telemetering signals to be transmitted simultaneously with other control functions.

If the interconnecting channels are not leased, perhaps the interconnecting means is by a privately-owned microwave system, in which a voice channel has been made available for telemetering purposes. This voice channel is very similar to a leased telephone circuit that is capable of carrying audio signals. That is, many audio tones can be impressed on the circuit (Maximum approximately 24) simultaneously, thereby increasing the usefulness of the single circuit. This is known as *Frequency Multiplex,* and is illustrated by Figure 1.

Audio circuits are more costly than DC circuits. However, if the information is needed fairly quickly and continuously, then the cost can be justified. If many readings are to be telemetered from various locations, and it is desired to reduce the leasing costs, which are a recurring charge, a simple system known as a *Time Division Multi-*

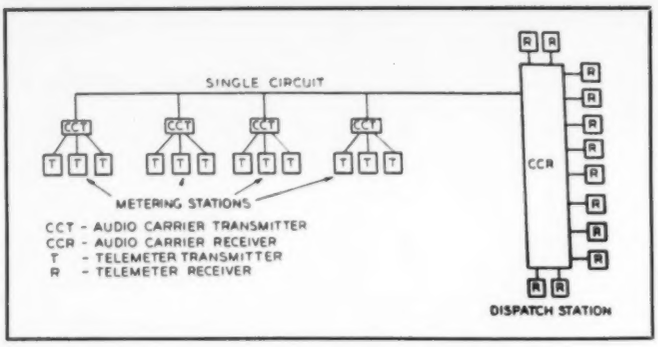


FIGURE 1—Frequency multiplex can be handled by simple interconnecting circuit. Audio signals can be impressed on the circuit—maximum 24—greatly increasing the usefulness of a single circuit.

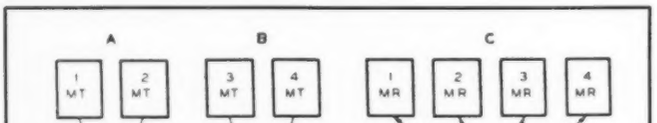


FIGURE 2—Time multiplexing equipment. The transmitter and receiving terminal consists of a scanning type stepping switch that permits one transmitter and one receiver to be connected to the interconnecting means at a time. Thus when stepping switch in transmitter steps to position 2, the receiver switch does likewise, connecting transmitter 2 to receiver 2.

plex can be used that allows up to 15 signals to be transmitted over a single DC circuit in a sequential manner. That is, one transmitter and one receiver are connected to the interconnecting circuit at a time on a time-sharing basis.

The time multiplex equipment (Figure 2) at the transmitter and receiving terminal consists of a scanning-type stepping-switch that permits one transmitter and one receiver to be connected to the interconnecting means at a time. The switches are maintained in synchronism so that when the transmitter switch steps to position 2, the receiver stepping-switch does likewise, thereby connecting transmitter 2 to receiver 2. Provisions are included in the telemeter receiver so that the recording pens retain their last reading until a new signal is received at the time the scanning switch returns to that position.

A means for maintaining synchronism of the scanning-type stepping-switches at all locations is included in a system of this type. In the example shown in Figure 2, a synchronizing pulse originates from the multiplex transmitter which synchronizes the intermediate transmitters and multiplex receiver. In the event of line failure or loss of power at the initial transmitter station, the system locks in a synchronizing position until the power or interconnecting circuit is restored. If the multiplex transmitter or any of the intermediate transmitters are at locations where frequent power or circuit interruptions are to be expected, provisions can be made to install a synchronizing attachment at the receiver location which will synchronize all of the transmitters from that point. However, under a scheme of this type, it is necessary that a duplex (two-way) transmission line be obtained.

When faster impulse-duration-type systems are made available, the use of time-division multiplex will become commoner. One of the present objections to a system of this type is that the time between samples is too long (approximately 3 minutes with 15 transmitter inputs), so that a faster impulse-duration-type system would permit a faster scanning cycle. Efforts along this line have been made using a voltage-type telemetering system, but the results so far indicate that a great deal of work will be needed to prolong the component life in such a system.

NEW TYPES OF TELEMETERING

In order to get a sound basis for discussing the new types of telemetering, it might be best to discuss the present impulse-duration system first, so that the advantages and disadvantages of this system versus new systems can be better analyzed.

As the name *Impulse-Duration* implies, the signal that is transmitted from an impulse-duration transmitter has a pulse, the duration of which is proportional to the measurand. Normally, a code is established such that a pulse of finite duration will exist at zero and maximum signal so that in the event of circuit failure the receiver will be able to alert the dispatcher that trouble has occurred.

A simple impulse-duration system is shown in Figure 3. At the transmitter terminal, there is a revolving cam that makes one revolution in 5 seconds and has a cam-follower resting on its face. When the cam-follower is on the cam, the switch is open; when it is off the cam, the switch is closed. The cam-follower is positioned by the bourdon spring, and when the spring is in its quiescent position, the output from the transmitter is a short pulse and a long period of no pulse, or space.

This, for instance, could be a 1-second *pulse* with a 4-second *space* on a repetitive 5-second basis. As the cam-follower moves across the face of the cam, the length of the *pulse* increases, and the length of the *space* decreases. At the maximum position of the cam-follower, which is equal to maximum pressure, we receive a 4-second *pulse* and a 1-second *space*. The *pulse* is transmitted from the transmitter to the receiver via the interconnecting means and energy from a DC power pack or battery energizes an electromagnet that in turn operates a differential gear mechanism. Basically, the differential gear mechanism is a timer that effectively measures the *pulse* and *no pulse* (space) very accurately, and positions a pointer or pen.

Advantages. There are several advantages to be derived from an impulse-duration system that should be considered at this point. The first is that only a DC circuit is required, but the pulse can be directly used with time and frequency multiplex systems. Second, a continuous sam-

pling of the measurand is obtained on a periodic time-basis so that a simple alarm system can be obtained to detect loss of signal. A third feature is that since the length of the pulse is directly proportional to the measurand, it offers an easy means for obtaining graphic records thru the use of simple electromechanical devices.

Digital Telemetering. If, instead of a graphic record, which is often referred to as an "analog recorder," we desire to have the information presented in digital or numerical form, we should consider the digital telemetering. For instance, we might want the information typed out on a piece of paper, indicated on a digital indicator, or perhaps stored for future use on a tape that could be programed into a digital computer.

There is a big difference between digital presentation and analog record in that the digital information is only obtained on time-basis or when a major or predetermined change occurs in the measurand. On the analog record, one can check the chart at any time and see what has happened during the entire day on a rather close moment-to-moment basis. Because of the complexity of the equipment, and because the circuit is normally shared with many other readings, the digital telemetering only provides a reading on a time-basis or a predetermined change. Of course, the equipment then operates only a small fraction of the time compared to a system that presents the reading in analog form, thereby reducing the wear considerably. Another big advantage of the digital telemetering system is that human errors are reduced because readings are obtained in a usable form, and if printout equipment is used, typographical errors can be eliminated.

A simple digital telemetering system would be one consisting of a teletypewriter at two locations. This is a familiar piece of equipment in most gas companies and can be either leased or purchased for telemetering purposes. At the transmitter terminal, the teletypewriter is supplied with a stunt box which allows the unit to be used for telemetering, as well as other control functions. A transducer is required that will convert the measurand (flow, pressure, etc.) to a teletype code. The transducer consists of a measuring element, a torque amplifier, and an encoder that takes the motion from the bourdon spring and resolves it into a thousand parts.

When the operator at the receiving terminal presses the the proper key, the teletypewriter at that location will interrogate the remote teletypewriter, and thru the stunt box obtain a reading from the transducer. This reading is then sent via standard teletype code to the receiving teletypewriter and printed out on a sheet of paper. Normally, provisions are included to label the reading with a code symbol so that at a later date the reading might be identified. The interrogation, of course, can be done on a time-basis, and many transmitters can be connected to a common teletypewriter receiver. Also, deviation contacts can be provided to give off-normal readings whenever the measurand varies from the normal zone.

More elaborate digital systems consist of binary codes that present readings on digital indicators or are converted to decimal form so that they can be printed on a standard electric typewriter. If it is desired only to have the record in digital form, then it is much more economical to transmit by digital techniques, so as to eliminate conversion at the receiving terminal. The digital method can have greater speed of response than present impulse-duration systems, but because many stations share a common interconnecting means, it usually takes more time to secure a current reading. However, the time delay is not such that this works any hardship, and off-normal readings are obtained on a more rapid basis. As mentioned previously, the digital equipment only operates when a change occurs, or it is called upon periodically for a status report. This type of equipment can operate equally well with DC circuits or with frequency multiplex. The digital transducer mentioned will be discussed in more detail further in this paper.

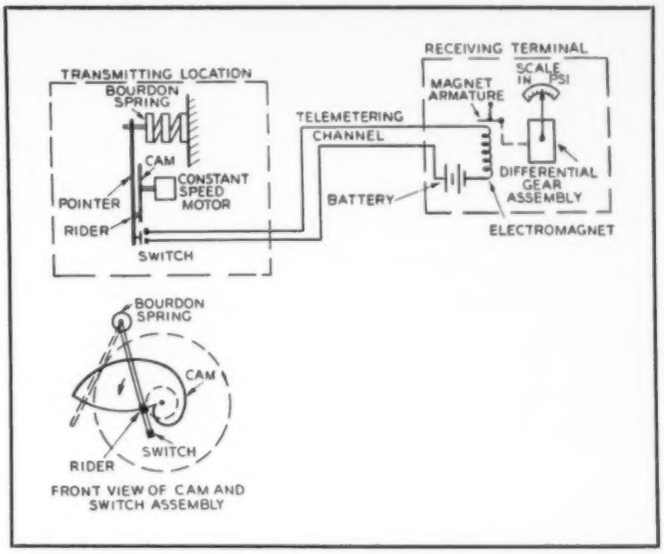


FIGURE 3—Simple impulse-duration system. Revolving cam makes one revolution every five seconds; the rider, or cam follower, which is positioned by the bourdon spring, rides over the cam, not around it. When the rider is on the cam, the switch is open. It closes when the rider drops off the cam. Thus an on-off signal can be transmitted.

Frequency Telemetering. Where fast speed of response and graphic records are required, frequency telemetering can be used. Whereas the impulse-duration system had its pulse proportional to the measurand, the frequency system has its frequency proportional to the measurand. There are many frequency telemetering systems available and normally the frequency range we are talking about varies from zero signal being equal to 13 cps to a maximum signal equal to 27 cps. The transmitting and receiving terminals are electronic in nature, and a transducer must be provided to convert the measurand to a resistance or millivoltage. The transducer again consists of a measuring element, torque amplifier, and resistance element, and is very similar to that used for the digital telemetering transducer. The output millivoltage or resistance changes the frequency of a local oscillator, and this is impressed on a circuit capable of passing 30 cps, or introduced into tone equipment that is capable of handling sinusoidal inputs. At the receiving terminal, the frequency telemeter receiver converts the incoming frequency to a millivoltage that is then recorded on an analog or graphic type instrument. Speeds of response better than 1 second over-all can be obtained with this equipment, and it is possible to frequency multiplex up to 18 of these frequency telemeter systems on one audio circuit. Figure 4 illustrates a

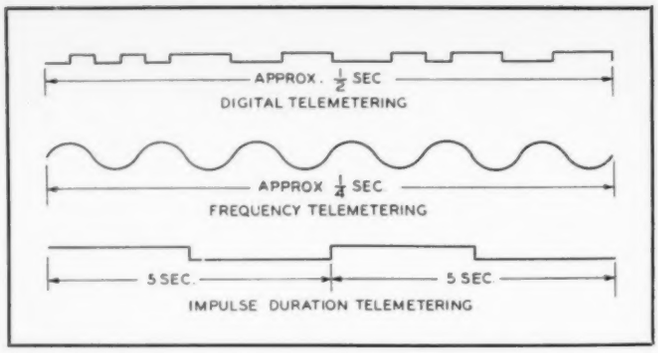


FIGURE 4—Comparison between digital telemetering and frequency system. Top portion shows a teletype code illustrating the number 682. Center is sinusodial wave of frequency telemeter transmitter. Bottom shows impulse-duration signal.

comparison between the digital and frequency system. In the top portion of the figure, a teletype code illustrating the number 682 is displayed as a serial-type code. In the center, a sinusodial wave illustrates the type of signal we might see on an oscilloscope if we were to examine the wave obtained from a frequency telemeter transmitter. The bottom section illustrates an impulse-duration signal.

NEW TRANSDUCER

In discussing both the digital and the frequency-type telemetering, we mentioned the need for a transducer that can convert the measurand to some other form. Normally, the amount of torque available from a bourdon spring, flow body, or temperature element, is rather small. Therefore, some means must be obtained to amplify this small amount of torque so that encoders or resistance elements might be positioned with great accuracy and high sensitivity. A transducer that can perform this function is illustrated in Figure 5. This instrument is capable of taking the small amount of torque obtained from the various measuring elements and then positioning encoders, slidewires, alarm contacts, deviation alarms, either separately or simultaneously. Figure 6 illustrates a very basic line diagram which illustrates how this is accomplished. In this case, a bourdon spring is used to position a differential linkage, which in turn is connected to the slug of a differential transformer. The transformer is connected to a very sensitive servo amplifier that is wired to a rebalance motor. The rebalance motor drives the output shaft that is coupled to the differential linkage thru a cam and roller assembly.

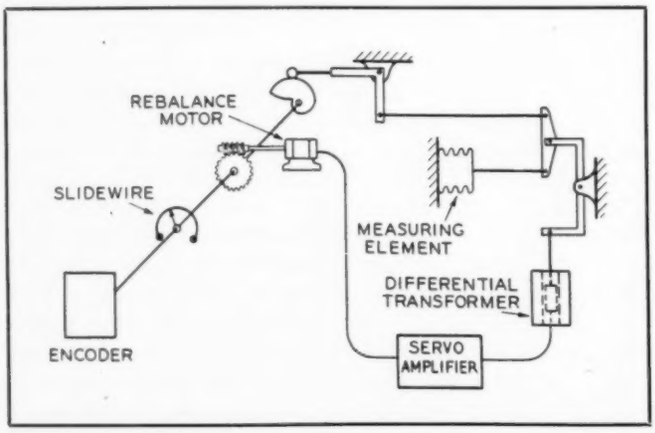


FIGURE 6—How the transducer works. Measuring element positions the slug of the differential transformer, which is connected to the very sensitive servo amplifier. This, in turn, drives the rebalance motor which repositions cam, encoder, etc. When proper position is reached, the slug is returned to original position.

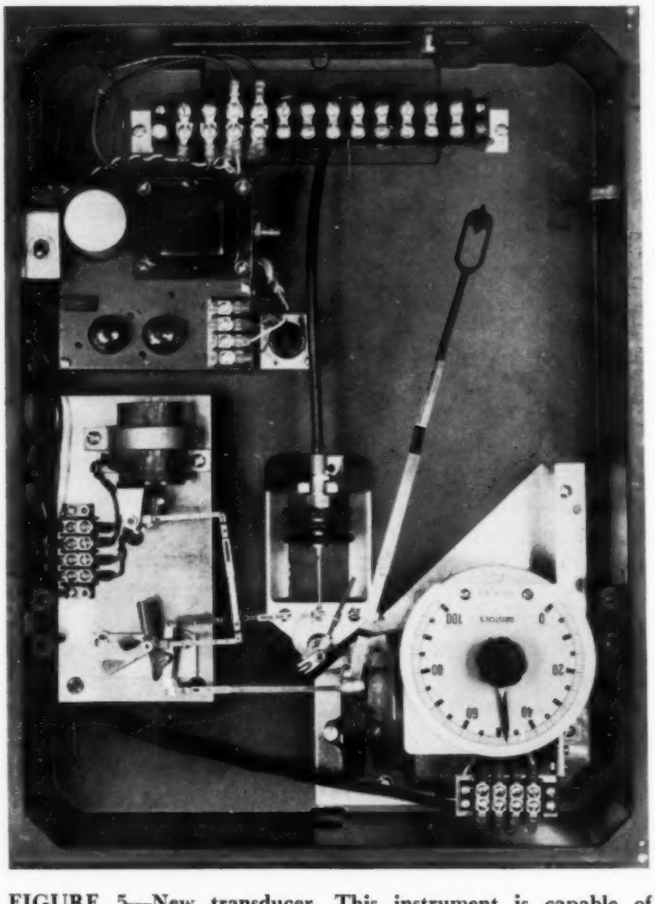


FIGURE 5—New transducer. This instrument is capable of taking the small amount of torque obtained from measuring elements then positioning encoders, slidewires, alarm contacts, etc., with great accuracy.

When the measurand changes, the position of the slug in the differential transformer is altered, thereby producing an unbalance voltage that is fed into the servo amplifier. The servo amplifier then energizes the motor so as to cause the cam and roller assembly to reposition the slug to its former position. The slidewires and encoders connected to the output shaft assume a new position, and this information is then transmitted to the receiving terminal. The cam that is connected to the output shaft can be characterized to extract square root or other mathematical laws, thereby increasing the versatility of the transducer. The servo amplifier can be either the vacuum-tube-type or solid-state-type, both of which are designed for maximum unattended operation.

FLOW COMPUTERS

As mentioned before, the transducer can be supplied with characterized cams for extracting square roots which are normally encountered in equations for flow. Therefore the same transducer that has been designed for digital and frequency telemeter use, is equally well suited for flow computers. In the case of the flow computer, the output, of course, is in the form of a slidewire position. Figure 7 illustrates the block diagram of a flow computer utilizing a transducer, as described, that is capable of ac-

About the Author

B. C. Joyce holds a BEE from the University of Connecticut. After graduation he acted as a supervisor at Whitney Blake and then went to The Bristol Company; he has been with that company approximately 10 years. Most of the time he has spent in the Application Engineering Department as an application engineer in the telemetering systems applications group.

Joyce has had wide experience in the gas transmission industry handling telemetering and computing projects throughout the country.

curately measuring flow corrected for temperature, pressure, specific gravity and supercompressibility. The latter two corrections, while they are normally included as manual adjustments, can be introduced automatically if these factors change frequently enough to justify the cost of automatic direction.

A single-case totalizer computer is included in this system. This is a new advance in that prior to this time two instruments were required to perform these two functions. This instrument has a sub-panel, which is illustrated in Figure 8, that contains several check switches that permits rapid check-out of the entire flow computer system, together with range-change switches and manual adjustments for specific gravity and supercompressibility.

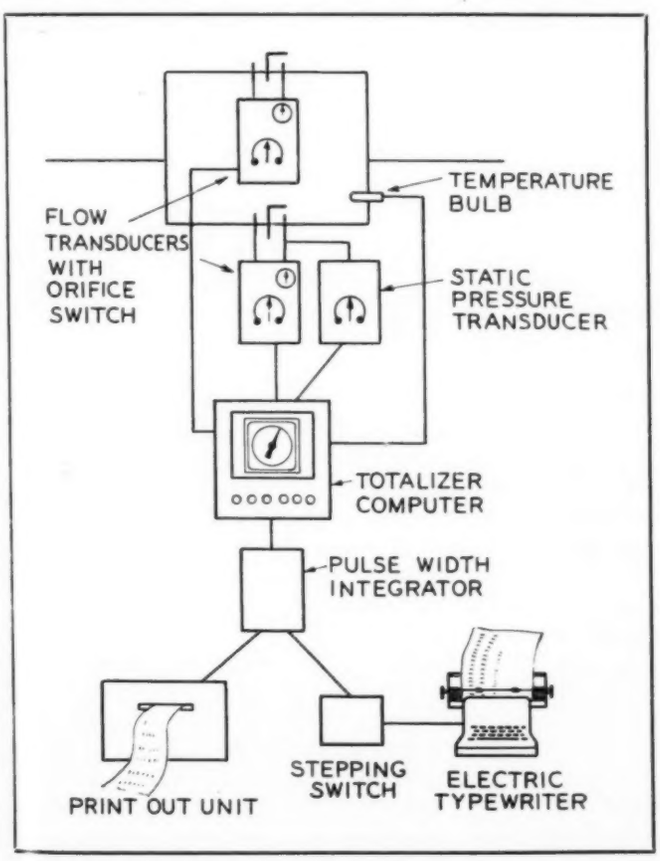


FIGURE 7—Block diagram of a flow computer utilizing transducers. It is capable of measuring flow, corrected for temperature, pressure, specific gravity and supercompressibility.

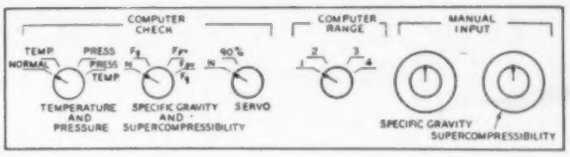


FIGURE 8—A single case totalizer computer sub-panel, which provides the means of rapid check-out, range change switches and manual adjustments for sp. gr., etc.

The check switches are connected to a flashing light that is located on the front of this instrument that gives a visual indication when one of these switches are in other than a normal position, thereby preventing the service personnel from leaving the computer in a check position. This lamp can be tied in with the output from the telemeter transmitter so that no signal will be obtained from the station when one of the switches is in a check position. Every attempt has been made to take advantage of suggestions made by users of this equipment who over the years have made recommendations on what would be desired from an operating and maintenance standpoint.

Another change that might be noted from the sketch is that by careful redesign and repackaging, the number of units required on a present-day flow computer are approximately one-half of what was required previously.

At the receiving terminal, integrators with electric range-change can be provided so that regardless of the range of the totalizer-computer, the integrator counter always reads correct mef. Simple print-out equipment has been provided which, on a time-basis (½ hour or 1 hour), will print out the total flow up to that time. Provisions are included to automatically reset the counter on a daily basis so that a permanent record of the total flow for the day can be obtained.

More elaborate systems which require digital logging of the flow on an hourly or half-hourly basis from several stations can also be obtained by use of an electric typewriter. In this case, the flow information is stored in stepping-switches, and on the hour or half hour the program unit associated with the electric typewriter will scan all positions printing out the hourly flow. Again, daily flow can also be stored with the reset feature mentioned on the simple station print-out system. On more involved systems using the electric typewriter, pressures, temperatures, and other readings can also be logged without too much difficulty. As mentioned earlier, when discussing digital telemetering, if it is the intent simply to log in digital form, a complete digital telemetering system should be considered, in order to avoid the conversion from analog-to-digital form at the receiving terminal.

CONCLUSION

In general, it appears that the main advances in telemetering and flow computers concern new techniques for presentation, faster speed of response, and the use of new single-case transducers. It is predicated, however, that we will be using the impulse-duration-type system of telemetering for many years to come in the gas industry, because of its basic simplicity, low cost, and ease of maintenance. However, it is well to be aware of what is available, since as systems become more complex and far-reaching, our present "tools" may not be able to handle the requirements in the most efficient manner.—**The End**

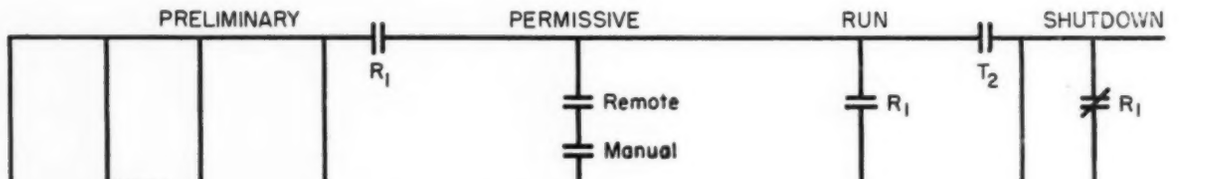
Let's Keep Automatic Controls Simple But Adequate

"Are we forgetting such things as simplicity, economy and purpose?", asks one of the pipeliners who led us to automatic operations in the first place

By Sydney S. Smith, Consultant
Scarsdale, N. Y.

CHANGE *per se* is not necessarily progress, especially if the end result is less economy or reliability. In the rush to glamorize automation with all the new hardware and gadgets which are being turned out, there is some danger that industry will sell itself some pretty expensive and perhaps not too reliable control systems. No designer should close his eyes to progress. On the contrary, he should open his eyes real wide and take a long hard look at some of the didos on his drawing board!

Philosophy of Control. Let's concern ourselves with the general philosophy of control for a moment. There are many ways in which automation may be achieved and there are correspondingly many types of automation "hardware." To name a few, we



ELECTRIC STATION SEQUENCE

FIGURE 1—A simple control system for a single unit, electric-driven centrifugal pump station which will function automatically on the line throughput with no remote control and no resident operators. The two relays and two timer relays provide the stop-start sequence of this simple four circuit system. (For explanation of how it works, see the text of this article.)

have the *'go' 'no go'* type which is essentially digital in concept; the *modulation or throttling type* which is analog; the *remote and supervisory type* which is usually digital in that it is a yes-no control; and the indexing or report back for supervision type which may be digital, analog or both. Unless the proper functional approach to each of these is made in one's thinking, strange results can accrue.

In the case of line pipe control we need to divide our items into separate categories which may be broken up as follows:

1. **The in station controls both yes-no and throttling or modular.**
2. **The pipe line controls, which include yes-no controls in the form of station start-stop, section start-stop or line start-stop.**
3. **The supervisory items reported back to enable control station operators to properly control the whole operation.**
4. **A less well defined area of control which takes care of line withdrawals to terminals, which may be entirely automatic-remote or a combination of automatic-remote and local—manual.**

I have defined these control types quite deliberately in the order of their importance, for no remotely operated system can possibly be better than the in-station automation on which everything else in the system depends. Thus the stations must be completely automatic and fail safe irrespective of the efficiency of the remote control system.

Simple-Single Unit Station—Example. So in an orderly approach to this problem let me describe first the stop-start operation of a simple single unit electric driven centrifugal pump station which will function completely automatically on the line thruput with no remote control and with no resident operators. The yes-no or stop-start sequence is a simple four circuit system containing two relays and two timer relays, as shown in Figure 1.

First is the permissive circuit which says to the station *do* run or *do not* run. It is a single wire circuit around the plant and in it we place all the remote switches, local manual switch, pressure switches, temperature switches, level switches, and gas analyzer switch which when all closed say to the station—get going, we have work to do.

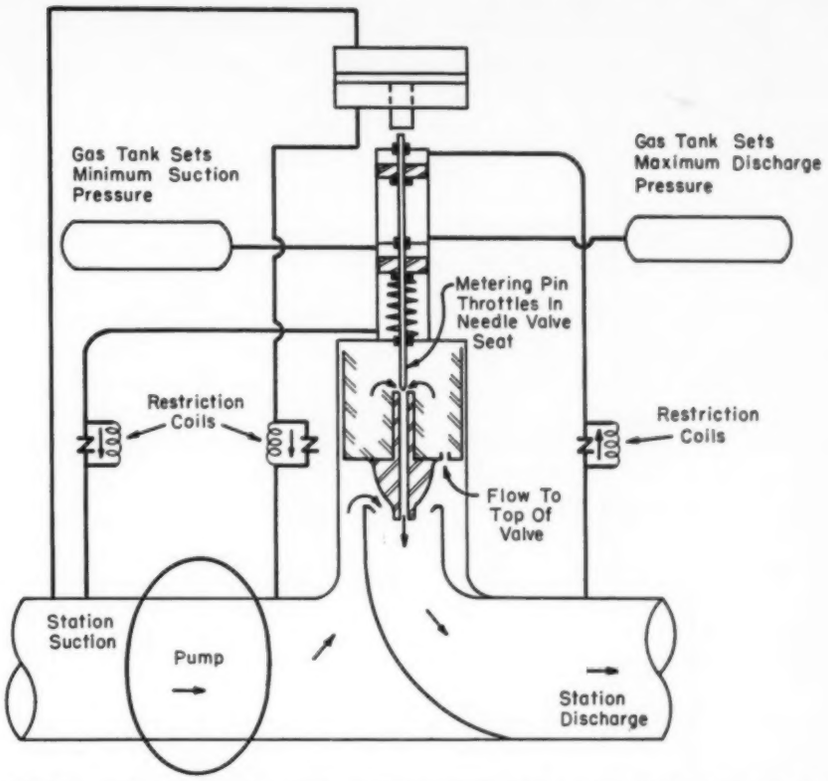


FIGURE 2—The modulation or throttling system of a station. Note that gas bottles are used instead of springs to set control points. The valve follows the control shaft from the diaphragm without actually touching it. The control is through the bleed. Similar equipment has been used on the Wolverine system for some years.

Each of these switches is directly functional to the thing it supervises. Each is two positions, *yes or no;* fortunately for fail safe operation if the circuit goes to ground, everything becomes inoperative, the station stops, closes its valves to isolate it from the line, and waits for an operator to come with help. The end result of this circuit is to close the permissive relay 1 (R_1) which in closing opens a contact to the shutdown circuit and closes a contact in the preliminary circuit.

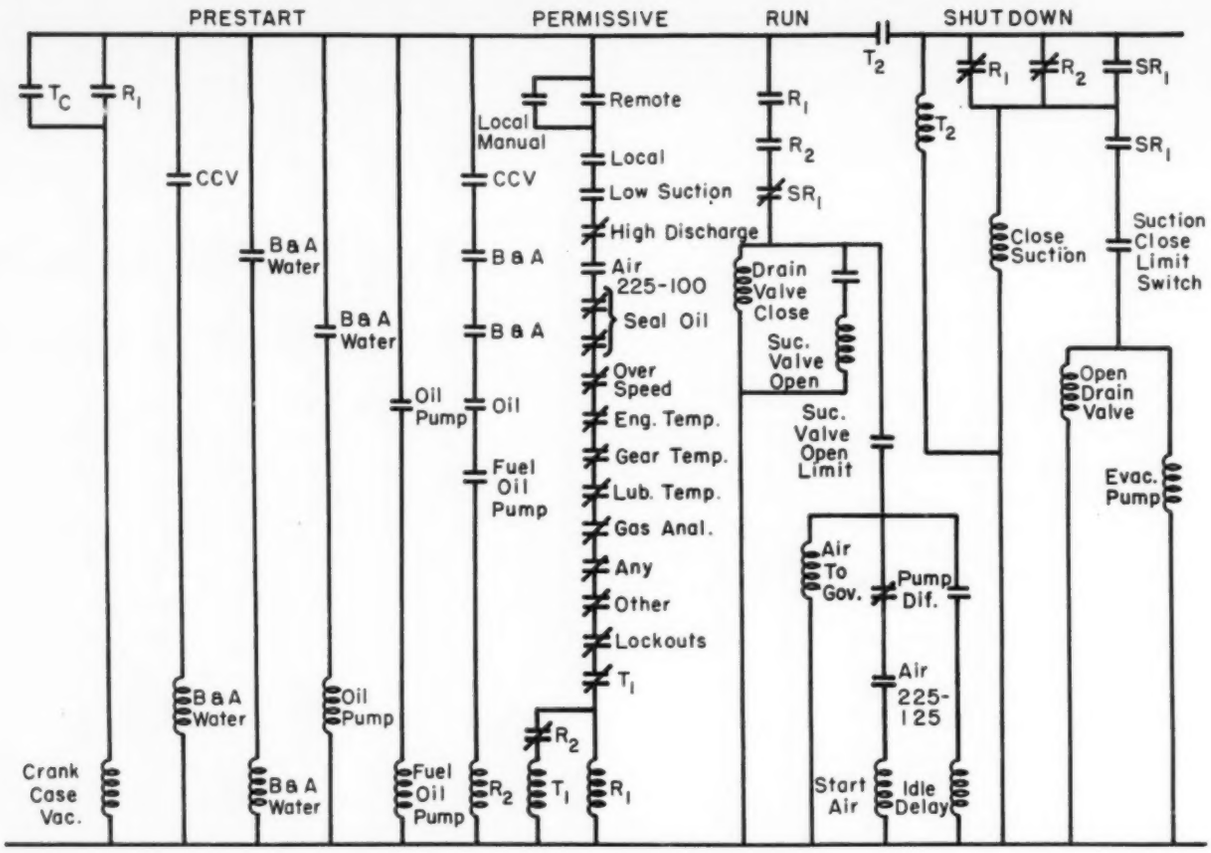
In the preliminary circuit we force sequence the starting of the main motor cooling blower, when it establishes pressure, another pressure switch closes the water pump circuit and a water pressure switch closes circuit to carry out the opening operation of the main station suction valve. Each of these force sequence switches has two contacts—when all are closed in the preliminary circuit we activate relay 2 (R_2).

Closed, both relays have second contacts in the run circuit which is a trigger circuit to main pump motor starter and to open the main motor operated discharge valve. When the pump starts and the discharge valve is fully opened the station is on the line and pumping.

Permissive Circuit Function. Now go back to the permissive circuit and note that in parallel with R_1 we have installed a timer whose series contact is back in the permissive circuit, normally closed, but opening after a set time limit. Unless both suction and discharge valves open within the set time this timer reopens the permissive circuit and the station comes to a stop. If either the water pumping or motor cooling ceases during operation we again time out with T_1 and the station locks out until the malfunction is corrected. If power failure occurs T_2 holds its contact open long enough for the full shutdown sequence to complete and then permits the station to resume operation.

Note that each circuit is a simple series circuit; each switch gives its own signal of where failure takes place; there are no complex annunciation circuits, no electronic tubes or transistors; the circuits do not require a highly skilled engineer to maintain, repair or reset conditions in the station.

Flow Rate Control. So much then for the stop-start circuitry. Any pipe line station must be controlled to pump at the line rate; this is accomplished by throttling the thruput to



DIESEL STATION SEQUENCE

FIGURE 3—Automatic control schematic for diesel driven station has same pattern as for an electric one. A force sequence is used for functions which must operate before main diesel is started. When R_1 and R_2 are pulled in they carry current to the drain valve motor, when it closes suction valve opens which permits air to be admitted to the governor and the diesel engine to start. Relay SR_1 is actuated by an incoming pipe line scraper and permits automatic bypass of scrapers.

maintain a minimum suction pressure or a maximum discharge pressure—whichever occurs first. Also when the station is called on to operate at two o'clock in the morning on a snowy night in February we're not going to have an operator on hand to twist the control knobs on a controller to get this station on the line without overloading the motor or putting destructive pressure surges on the line.

Figure 2 schematically depicts the entire modulation or throttling system in the station. It consists of a single seated valve actuated by a hydraulically balanced piston, which provides the energy required to balance or move the valve. The liquid which leaks around the piston can be discharged through the small passage and is throttled by a small needle valve in this passage. This small needle valve is itself actuated by either of the two superimposed pistons each in its respective cylinder. The lower unit is null balanced between fixed gas pressure over the piston and station suction pressure under the piston. The upper unit is similarly balanced between station discharge pressure over the piston and fixed gas pressure under the piston. Rate control of valve movement is provided to each cylinder by a restriction tubing coil bypassed by a check valve so that either piston can operate rapidly toward valve closure but only at regulated rate toward valve opening.

These restriction coils are more reliable than orifices or variable valves and provide control of rate of opening of the main valve. When properly adjusted to the individual pump and motor and to the line section into which the station pumps they always provide asymptotic approach to the control point and positive prevention of hunt.

If the station does not use a motor operated discharge valve, but instead discharges through a soft seated check valve, a closed discharge valve start is required. This is provided by adding a third and larger cylinder at the top of the cylinder stack. This cylinder is constructed with a differential type piston so that equal top and bottom pressures extend the differential rod. Thus, when extended and bearing on the pilot stem the main valve is closed.

Pump discharge pressure under the piston and suction pressure over the piston provide upward movement when the pump is at full speed and again a restriction coil provides the first opening rate of the valve after main pump starts. This restriction coil is made long enough to provide an extremely slow opening and allows motor pull-in without overloading on the first rush of liquid through the pump.

Note that we have no air compressors, no air dryers, no freeze-ups, no electronics, no electro-hydraulic pumps and oil circulation, and finally, and most important, no knobs for the casual caller to twist. Thus once adjusted to proper rate action for the motor pump and line section in combination this valve remains a permanently adjusted unit which needs to have its 'O' rings looked at once a year, and its gas tank pressures checked weekly by a maintenance man; otherwise it is best left alone.

This then is the entire control system for a completely automatic station with all its necessary fail safe items. Many things can be added in the dis-

cretion of the designer by simple insertion in the permissive or preliminary circuits, but no less than this shown can be tolerated if remote control is to be used.

If the remote control system is set up to leave the station in its last remotely set condition, failure of the communication circuits will not stop the station, but an upstream or downstream stoppage of the pipe line will stop it. Further than this proper selection of spread setting points on the suction and discharge pressure switches will stop and start the station properly on the flow within the pipe line, so that remote control is not even necessary unless desired for other reasons.

Controlling a Diesel Station. Full automation of a diesel driven station follows the same general pattern as the electric station. The same force sequence is used on the greater number of items which start before the main diesel. In the run circuit R_1 and R_2, when pulled in, carry current to the drain valve motor; when that valve closes the suction valve opens, when the suction valve is open air is admitted to the governor and to the diesel start. When the diesel fires, the main pump differential cuts the starting air and pulls in a solenoid which operates the delay cylinder which holds the engine at idle speed for a definite warm up time.

In the upper right of the electrical diagram SR_1 is a relay actuated by an incoming pipe line scraper. When actuated, SR_1 in run circuit opens, shutting down the diesel, SR_1 in the shutdown circuit closes suction valve then opens a drain valve and starts a drain pump which pumps the station liquid into the line. The purpose of this circuit is to automatically pass scrapers and a batch interface through the station while the station is drained of liquid thus providing an absolutely clean interface through the station.

Simplicity in Control Is Vital. It is obvious that automation of an electrical station or a diesel station can be basically simple. But not so simple is the basic philosophy of controls.

The purpose of remote control is of course to permit operation without local operators. Now the question becomes, how much supervisory data do we need at control point? First we need to know whether a station is operative or not. Many supervising operators demand to know whether a shutdown is caused by line conditions, by mechanical failure or by electrical failure. Where control is made so straightforward that any good pipeliner can understand and adjust any part of the electrical circuitry in safety, as it is in these circuits, it seems rather unnecessary to delineate over the remote system whether a failure is mechanical of electrical; the same crew would be called out to correct the condition in any event.

But to index whether the station is running or not can be done in several ways. Some lines may be so arranged hydraulically that it is desirable to know the operating pressures in each station. In this event many operators require constant monitoring of all station pressures. This requires multichannel control circuits and adds to communication costs. A more practical method is to use the same communication channel for both control and indexing, using a selector method to temporarily report back pressures from any selected station. In the case of diesel stations it may be desirable to report back revolutions per minute in addition to operating pressures for these can be put together to indicate the gravity of product passing the station. In the same connotation it may be desirable to report case pressures from fixed speed and throttled centrifugals for the same purpose.

However if the stations are electric as first described, and if the throttling controls are reliable as described it is sufficient in most cases to use a simple differential pressure switch to show operation of the station over the remote system. In this case the central control panel will only have lights to show station operation, or non-operation, and the pressure control switches in the stations themselves will handle the necessary stops and starts.

In general when we sort out the problems of automation into their proper categories we find that all of the problems are directly functional and quite simple. This applies to pipelines—and it also applies to plant processes.

Summed up, the control engineer's responsibility is great. There are many functions at stations, in plants—and for that matter even in laundries and grocery stores—which can easily be controlled. But do they need controlling in the first place? It is strictly up to the control engineer to make the proper choice of function and instrument, and that can be done only through thoroughly understanding the plant, the variables and the desirability and economy of controls.

Another way of putting it: with all our missile tracking radar equipment which is available today, it would not be difficult to develop equipment which could greatly excel the ordinary duck hunter. The equipment could track the flight path of a hapless duck and *automatically* intercept it with the blast of an *automatically* controlled shotgun. But we would be forgetting *purpose, economy* and *function!*

Let's not forget these factors when we design our pipe line installations.

ACKNOWLEDGMENT

Presented at the NGAA Rocky Mountain Regional Meeting, September 17, 1959, Casper, Wyo.

About the Author

Sydney S. Smith is one of the great creative men in the pipe line industry. He pioneered many of the automatic features in pipe lines and in refineries and gasoline plants. He was graduated from Marietta College in 1915 with a major in mathematics and physics. He joined his father in selling pumps and compressors. In 1924 he became manager of the natural gas and gasoline division of Roxana Petroleum Corp. In 1935 he became consultant in the Manufacturing Department and three years later he was appointed manager of Shell's products pipe line division. While with Roxana Petroleum, he developed methods of column control which were new at the time; later with Shell, he was the originator of the measured mile system of meter calibration, automatic electric and diesel stations and the elastomer spheroid used for product separation in pipe lines. Following retirement from Shell, he has been doing consulting for pipe line companies and manufacturers. In World War I he served as a second lieutenant in the U.S. Army Balloon Corps. He received the Medal of Merit in World War II for developing portable pipe lines for military supplies.

How Transco Cut Tower Maintenance

Contractor used spray painting technique from two bosn's chairs to scrape, wire brush and paint 280-foot microwave towers in one day

By Jay C. McElroy, Engineer of Communications
Transcontinental Gas Pipe Line Corporation, Houston

MOST RADIO communication men are not painting experts, but they are often faced with the problem of keeping microwave or VHF towers covered with a good coat of paint. On the Transcontinental Gas Pipe Line Corporation system we had 55 guyed towers on which the paint had been peeling badly. These towers were located approximately 30 miles apart and generally in sparsely populated areas. In most locations we were not bothered with any special corrosion problems; the towers were well galvanized and we were primarily concerned only with getting on a coat of paint with good adherence and color retention.

Spray Painting Saved 20 percent! After reviewing the proposals of several contractors, we decided on one using spray painting. We thought there would be three advantages in that method—it should save 20 percent in the cost, give better paint coverage and require a minimum amount of time. An extra saving to us also resulted because the inspector was on the job a shorter period of time.

Painting Procedure. After experimenting with the first four or five towers, a method was perfected whereby two contractor's men, with the help of the company inspector on the ground, could scrape, wire brush and paint a 280 foot tower in one day. The crew was equipped with an air compressor mounted on the bed of a truck, two lengths of hose sufficient to reach the top of the tower, two paint rigs each containing two three-gallon paints pots and two spray guns, plus two boatswains chairs for the men.

When the crew arrived at a station, our inspector would climb the tower to inspect the antennas, line, and hardware while the painters unloaded their equipment. When they had unloaded, they climbed the tower, taking a line up with them and began cleaning the tower. After the inspector completed his inspection, he would send up one paint rig to the bottom of the top color band, and both boat-

Last Call for Tower Repainting

MOST PIPE LINE companies have already repainted their towers in accordance with the new FCC requirement that white and orange bands on the towers be of equal width. However, on a recent editorial junket we counted three towers that still had the old markings . . . doubt that any were pipe line towers.

For any tower owners who haven't met the new requirements, the Federal Communications Commission has reminded all owners in its Public Notice G-78935, that Jan. 1, 1960 is the deadline for complying with the rule requiring that alternate white and orange bands be of equal width. Prior to 1953, the FCC required that white bands be approximately one half the width of the orange. At that time the FCC specifications were brought into conformity with the national standard on obstruction marking issued by the Air Coordinating Committee.

To avoid undue hardship on tower owners the FCC set the delayed deadline of Jan. 1, 1960 for meeting the new marking specifications. For those who haven't met them here is a "final" reminder.

The Editor

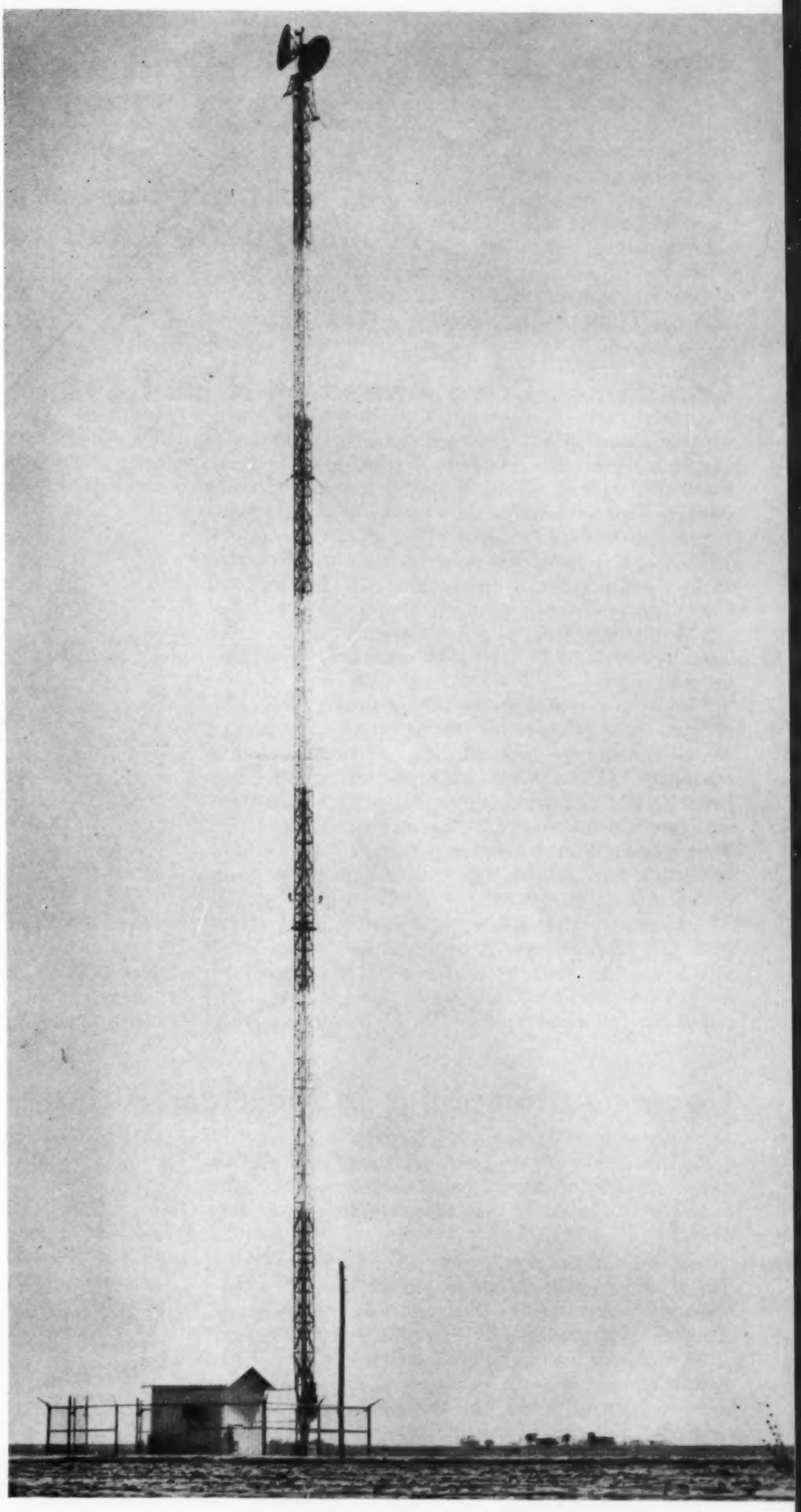
Costs

swains chairs. One painter would begin to paint at the top, while the other finished cleaning the tower. After the tower was cleaned, the other paint rig was sent up to the second painter at the bottom of the highest unpainted section. He would then begin painting three sides of that section, leaving the other side to be painted by the man above as he came down. Paint pot rigs were equipped with both white and orange paint, so that the painters simply changed guns as they entered a different color band.

Few Weather or Wind Worries. When the job of painting the 55 towers began, both Transco and the contractor faced unknown risks. As always, the contractor had to take the chance that he could perfect a safe production line method and complete the job within his contract price. Transco's risk involved possible loss in good will—and perhaps money, too—if paint should blow onto the property of others. None of these risks turned out to be a problem.

The job was started during the month of June to take advantage of the best weather conditions; the crew was delayed by weather only two days. This was because of high winds. Only in one case was there any damage resulting from floating paint and this was on one of the first towers painted.

Speed of painting progress discounts the risk to the contractors. One crew completed the 55 towers in 42 working days. Effectiveness of the painting application has been shown by experience; the first towers painted by this method were painted over five years ago and none have required repainting yet. —The End



A typical Transco microwave tower located in South Texas cotton fields. Spray painting in sparsely populated areas created few problems for the painting contractor. Fifty-five towers along the system were painted in 42 days.

Pipe Line Pete's

IDEAS FOR THE FUTURE!

. . . in pipe line engineering, construction and operations

By Donald M. Taylor, Consultant, Houston

Companies Drive Ahead on H Fuel Cell Research

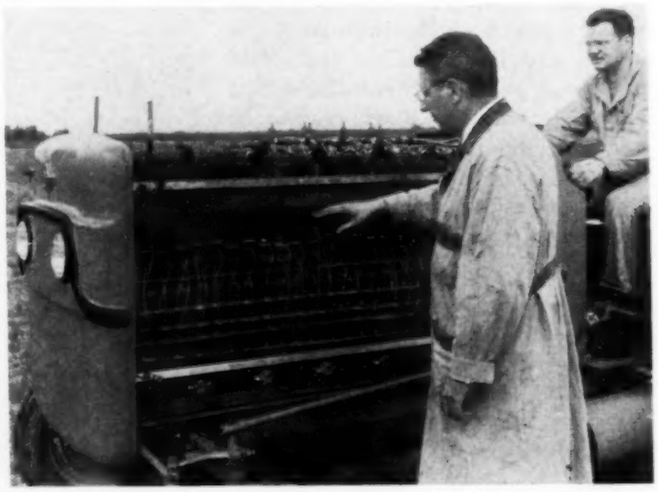
No less than 20 major research projects aimed at converting fuel energy directly into electrical power by chemical means are underway in U.S. laboratories, and similar projects are known to be underway in Russia, Germany, France and England.

The hunt for electrical power sources not dependent on mechanical drives is divided into two separate fields. One is thermoelectric; the other electro-chemical.

The thermoelectric principle depends on converting heat directly into electric power—primarily by utilizing thermocouples.

The electrochemical process utilizes a chemical reaction between an oxidant and a reductant to produce electrical energy. Some of the companies engaged in research projects in this field are: General Electric Co., National Carbon Co., Allis-Chalmers, Chrysler Corp., Universal Winding Co., Curtiss-Wright, Consolidation Coal Co., Westinghouse, Ford Motor, Esso Research, Dow Chemical, RCA Laboratories, the U.S. Army Signal Corps Laboratories, and Mine Safety Appliance Co.

The most popular chemical combination being studied today is a reaction between hydrogen and oxygen which produces water and electrical energy. Most promising recent development has come in the field of molten alkali carbonates contained in a matrix of magnesium oxide. Reductants used are carbon monoxide, natural gas or other hydrocarbons and the oxidants are oxygen or air. High temperatures are necessary to maintain the molten salts, but the efficiencies are high enough to excite researchers. New fuel cell-powered tractor, shown above uses propane and air.



Electric Automobiles in the Near Future?

*Remember the Book Tom Swift and His Electric Auto?** This beardless—but fictional—inventor had more discoveries to his credit than those claimed by the Russians.

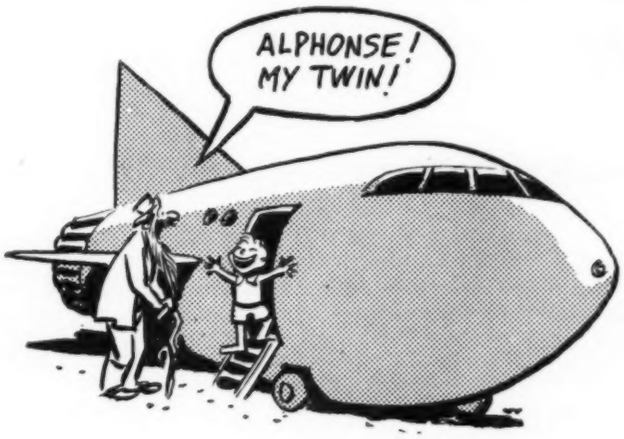
In any event, the electric auto is here. Stinson Aircraft Tool & Engineering Company has developed a four-passenger coupe which will travel 78-miles between recharges—*which cost only 18 cents each.* It has a top speed of 58 miles per hour. The drive comes from two 3.2-hp electric motors. Powered by 48-volt, 260-ampere-hour selenium batteries which can be recharged at night by rectified 115 V current from the home.

The cost of the car is $2,800, and there are plenty of takers on the West Coast, according to the *Wall Street Journal.* However, this innovation will not likely make any great inroads on gasoline consumption so vital to our pipe lines. Its range limits it to town driving.

* If it turns out there's no such book, just forget it. *Please* don't write the editor and tell him what a dolt I am. I need the money he pays me for writing this. Besides, maybe I'm referring to one of those Swift boys who used to live out from Colorado City, Texas, or was it Roscoe? Seems to me one of them was named Tom. By golly, it was! Tom Swift! What's more I think he moved to California and bought an electric auto.—Pete.

Your Son Can Become Older Than You?

Take a pair of twins. Load one of them into a space ship and let him orbit at high speed through the universe, and he'll return younger than his brother who stays home —according to Einstein's theory of relativity. Moreover, if he orbits at 186,000 miles per second (the speed of light and radio waves) for about 20 years, he'll return to find the earth millions of years older!



Well.

To test the accuracy of this theory, Hughes Aircraft Company research laboratories designed a clock which ticks some 24-billion times per second, and it will neither gain nor lose 1 second in 1,000 years! (It was developed under the sponsorship of the National Aeronautics and Space Administration.)

The test will be simple. Synchronize two such atomic clocks. Heave one of them into space and see if the traveling clock goes out of synchronization with the ground clock as it travels.

As any fool can see, this experiment has great implications. Just think! Take a trip around the solar system and come back to find you are years younger than that cute chick of a secretary.

H-m-m. Now if I understand this theory of Einstein's, speed slows down time. Now suppose I could go faster than 186,000 miles per second. Maybe I'd get younger. Maybe I could even grow some hair . . .!

Better Measuring Equipment for Suspended Droplets

Through the sponsorship of the National Inventors Council of the U.S. Department of Commerce, work is being directed toward the development of an automatic or semi-automatic device to count cloud droplets in different size ranges. If successful, this could help us discover more about two-phase flow. Too, it could mean better weather predictions.

The present method used to determine the drop size distribution in clouds is to collect droplets on a slide and make photomicrographs. Droplet sizes in a cloud range from one micron to 100 micron radius.

The Council would particularly like a device that could be used for either liquid or solid particulates from a cloud.

Better Weather Forecasting Is Coming

Electronic brains and automatic observation posts may mean more accurate weather forecasting in the future. The Weather Bureau, the Air Force and the Federal Aviation Agency are joining forces to implement the new system. One source of added accuracy will be a reduction of one-third in time lag between observations and forecasts.

Who's Walking These Days?

Who walks?

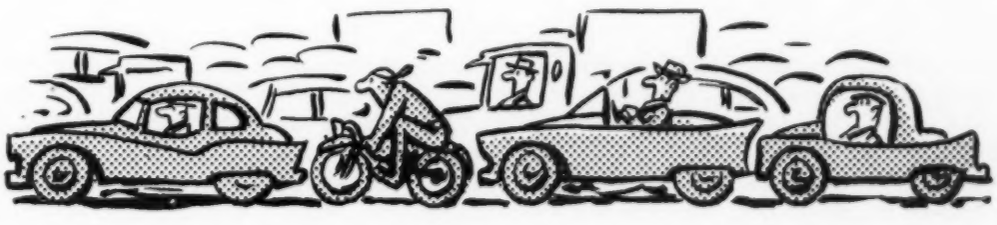
Just Harry Truman and a few golfers who haven't succumbed to the lure of the golf cart, it seems. In the U.S., little tots are riding kiddy carts; 5-year olds are riding tricycles; cub scouts are riding bicycles, young teenagers are riding motorscooters *and the rest of us are riding the 70.4 million motor vehicles which the U.S. Department of Commerce says will be licensed in this country this year!*

Passenger car registration will be 3 percent higher than last year's totaling 58.6 million autos. Truck registration is up 3.5 and by the year's end 11.8 million of them will be registered.

Percentage-wise, this reversed the declining increase of the past 3 years. Here's the way motor vehicles have been climbing in recent years:

1954 .....4.1 percent	1957 .....3.0 percent
1955 .....7.2 percent	1958 .....1.7 percent
1956 .....4.0 percent	1959 .....3.1 percent (estimated)

The Bureau of Public Roads report lists the three leading states as California, with 7.3 million vehicles, New York with 4.9 million and Texas with 4.2 million.



Rules of Thumb

and Engineering Data Sheets for the Pipeliner's field notebook

$25 for Engineering Data Sheet $15 for Rule of Thumb

These practical aids give quick, reasonably accurate answers to design, maintenance and cost estimating problems. PIPE LINE INDUSTRY will pay $25 for each chart, nomograph or data sheet published—$15 for each Rule of Thumb. Send your ideas to PIPE LINE INDUSTRY, P. O. Box 2608, Houston, Texas

Engineering Design

—67—How to estimate crude gathering line thruput for a given pipe diameter

To select the proper size line or estimate thruput for West Texas crude oil gathering lines, an engineer with a leading oil company has devised this handy rule: **Thruput in barrels per hour is roughly equal to a constant times the square root of pressure drop per mile (psi/mile).** Constants were derived from field data for various diameter lines between 2 and 10 inches.

Pipe diameter (inches)	Constant (K)
2	7.8
3	19.2
4	37.8
6	105
8	209
10	385

Example: What size gathering line would be required to move 240 barrels per hour of West Texas crude through a 10-mile line using a pump discharge pressure of 400 psi? Assuming no significant changes in head due to elevation and a pressure drop of 40 psi per mile, for the first trial calculation a 4-inch line appears to be the best choice so try the constant 37.8.

Thruput (4-inch) $= 37.8 \sqrt{40}$

$= (37.8)\ (6.4) = 241$ barrels per hour. So a 4-inch gathering line will be adequate.

This rule was found to be useful and reasonably accurate for estimating thruputs of West Texas crudes having API gravities in the 30-40° range and viscosities in the order of 40-70 SSU.

Miscellaneous

—40—List of typical specifications used for domestic and commercial natural gas

1. **Heating value:** Not less than 950 Btu's per std. cubic foot.
2. **Purity:** The gas to be delivered shall be free from dust, gums, crude oils, hydrocarbons liquefiable at temperatures in excess of 15° F at 800 psig.
3. **Sulfur content:** The gas shall contain not more than one grain of hydrogen sulfide per 100 cubic feet of gas, and not more than 20 grains of total sulfur per 100 cubic feet of gas.
4. **CO_2 content:** The gas shall contain not more than 2 percent carbon dioxide.
5. **Moisture content:** The gas shall contain not more than 4 pounds of water vapor per MMcf of gas measured at a pressure of 14.4 psi and a temperature of 60° F.
6. **Temperature:** Maximum temperature at point of delivery shall be 120° F.

Engineering Design

—68—Estimate the optimum working pressures in crude oil transmission lines

The approximate economic optimum working pressure in psi = 1,250 - 15 × O.D. of line.

Example: Estimate the maximum economic optimum working pressure—which is usually station discharge pressure—for a 20-inch crude oil pipe line.

Solution: Approximate maximum working pressure = 1,250 - 15 x 20 = 950 psi.

If the line profile is approximately horizontal, the maximum working pressure occurs at the discharge of a pump station. This method is useful only for approximations.

Be Sure You Write What You Mean!

If your writing is ever misinterpreted or ignored, then you have a communications problem. Here are some points which will enable you to improve your letter and report writing

By B. J. Wachter, staff engineer
National Aluminate Corp., Chicago

WE SAW an accident recently where a small foreign car crashed into the rear of a trailer truck. The truck driver, looking for all the world like a truck driver, approached the driver of the foreign car, a mild mannered man. The preliminary exchange was brief and well punctuated.

Truck Driver: "What are you going to do about this?"

Mild Mannered Man: "I think we can settle it amicably . . . ."

Without another word the truck driver swung. Apparently he took offense at the word "amicably" not knowing (or caring for that matter) what it meant. He probably didn't realize he was taking offense. He was just plain mad.

Since this was a face-to-face situation the misunderstanding was eventually cleared up. (Ultimately, amicably). But it made us stop and think. If one vocal word could cause such a ruckus, how did the hundred thousand odd words we wrote in the normal course of events last year fare? All of these words, unalterably put into type, conceivably could cause mayhem. We don't think they did though. Very likely most of the words were lost irrevocably. They "withered on the line," so to speak, without being plucked by appreciative readers.

Whenever our written words are misinterpreted or just ignored we have a problem in communication. This is a serious problem since we have definite responsibilities in keeping the word-mill running efficiently. We have to exchange information with our contemporaries and associates on everything from aardvarks to zirconium, and we have to write it down to make sure they (and we) get it right. Let's stop and think about this for a while.

Between The Lines. When we stop to think about it we realize that we can't write writing. Writing is a way of communicating and the written word is just a one dimensional idea. It only becomes full bodied when it expresses what we mean and is properly interpreted by the reader.

In this sense we might compare the written word to a crocodile egg. To illustrate: Let's consider that the mature female crocodile lays 100,000 eggs every year with only 100 being fertilized. Similarly, we might write 100,000 words every year and only have a small fraction of them reach full maturity by fulfilling their intended purpose.

The crocodile situation is of concern only to crocodiles. However, there should be a human concern too—about nurturing embryo ideas through effective writing. This concern leads us to consider what is involved in written communication. We find that writing (like Gaul) is divided into 3 parts. It consists of:

1. The writer
2. The written word
3. The reader

In studying the relationship between these parts certain gaps become apparent. These gaps occur between the lines, thus our ideas may either lose something or be distorted in translation. Let's consider briefly what goes on between the lines.

You and Your Words. Psychiatrists, in treating mental patients, often use a word association test. This involves reading a list of words and asking the patient to respond to each word with another one. A patient may respond to the word "red," for example, with: "hair," "anger" or even "communism." The pattern of responses sometimes gives

Putting words together is a personal process. However, these combinations can be as unappealing as cold gravy or as pleasantly provocative as a well-turned ankle

an indication of an underlying emotional problem.

The word association test illustrates that words are associated with feelings or emotions. (It also illustrates that a word is a word is a word is a word.) This is true for normal people as well as mental patients. Therefore, even though we understand the meaning of a word, we nevertheless tend to associate it with personal experiences. Thus, many times these word associations come out in our writing. In these cases, our writing does not represent our true intent, but rather, our automatic emotional response in a given situation. Each of us can break this word association pattern by carefully differentiating between facts and feelings.

Summing up: Effective writing requires conscious effort. Thinking is the pause that expresses.

The World of Words. Don Marquis wrote the following lines which apply, to a certain extent, to all of us.

"I do not work in verse or prose,
I merely lay out words in rows;
The household words that Webster penned,
I merely lay them end to end."

Although verbal "brick-laying" is sometimes acceptable, when words are used as building blocks the final result depends on the architect. The finest words Webster has to offer are meaningless unless they are properly built into our writing.

We have certain guides for "building" words. Grammar affords a very broad blueprint. Form and style have also developed some standardization through usage. There are no specific rules, however, which dictate how to write. If there were, we might end up with "word communism" and identical word structures, like universally identical buildings, would result.

Summing up: Putting words together in writing is an individual and personal process. Word combinations can be as unappealing as cold gravy or as pleasantly provocative as a well-turned ankle.

Interest the Reader. A reader, by natural disposition, is lazy. His voluntary status as a reader is strongly dependent on one motive: self-interest. This may take the form of obligation, intellectual or emotional satisfaction or just plain curiosity. The reader likes his writing short and simple so he can decide quickly whether or not it involves his self-interest.

It is important that these basic interests be taken into consideration in writing. As writers, however, we must do more than appeal to the reader's interest in saving time. We must use empathy—put ourselves in the reader's shoes—to present our thoughts in a way he is most likely to accept them.

Clarence Darrow, in speaking to a group of English professors, once said, "Even if you do learn to speak correct English, who are you going to talk it to?" This question also applies to writing. The most profound writing will never be fully appreciated unless it is read, understood, and accepted by the reader. Spanning the gap between the written word and the reader is a challenging job in creative bridge building.

Summing up: Writing involves a dynamic interaction between writer and reader. It requires all of the ingenuity of the schoolboy's letter home for money.

Three Questions. After recognizing that writing is a personal process requiring effort and understanding of the reader, where do we go from there? The professor of a short story course when asked a similar question, "How do I begin writing a short story?" replied, "Drop this course, go home, and start writing." In short, the answer is practice—we need to practice to improve our writing. In fact, each time we write, we might ask ourselves 3 questions:

1. What do I want to say?
2. Does my writing say it in the clearest possible way?
3. Are my thoughts presented in the form most acceptable to my readers?

If we can answer these questions to our own satisfaction we are "on our way" in making our writing more effective. But maybe now we need a few checks for objectivity to be sure that the individuality of our writing does not get out of hand. Let's, therefore, recognize certain extremes in individuality which we will caricature as: the Dictator, the Educator, the Hourglass and the Dumptruck.

The Dictator. We have difficulty in looking between the lines of the Dictator's writing since there is no between. His written communication is blunt and to the point; it is black on black and we dare you to find shades of grey. This has its good features since it leaves no gaps between writer and writing, but it is not true communication since it meets a Waterloo in the reader.

This type of writing is effective, however, in direct proportion to the obligatory nature of the reading. It is good only insofar as the writer's ideas are infallible, since the written idea will never require reader interpretation. On the other hand, it will very likely suffer because of reader resentment.

In reply to an inquiry such as:

"I am searching for a new plant site in a warm climate with good fuel readily available and good labor supply. Where would you suggest I look?"

A typical response from the Dictator writer would be direct and to the point: "Go to hell."

The Educator. The Educator writes tangentially. His fetish is completeness. He begins at the beginning and works methodically from there, getting off on frequent tangents which in due course have little relationship to the original issue. The Educator is an effective communicator, but the prime requisite for his reader is patience.

In response to the same inquiry given above, the Educator's reply would run something like this.

> "The first plant sites were always located near accessible water supplies. This was because water was the earliest source of transportation. Some difficulty was experienced originally in this country when Indians repeatedly attacked plant sites. Some of the tribes of Indians which were common during the early days of our country's development were the Iroquois, the Sioux . . . etc."

Ultimately, he would formulate a good answer to this inquiry, but not until such things as the customs of the early Indians, and the effect of glaciers in cutting out waterways, were fully explored.

The Hourglass. The word "urgency" is not to be found in the Hourglass writer's vocabulary. The sands of time run slowly through the constricted area of his brain. Ideas are like individual grains of sand which flow constantly, but very slowly. For example, replying to the same inquiry, the Hourglass writer might say:

"What type of plant are you putting up?"

After the reply is received giving all the pertinent facts on the type of raw materials, processes, and finished products involved, the Hourglass writer is likely to reply:

"What type of fuel were you interested in?"

Presumably, after this point has been cleared up, a clarification of the type of labor supply would be requested.

The Dumptruck. The Dumptruck writer is prone to unload all of his ideas on a given subject at the slightest provocation, a process quite similar to free association. The method does not necessarily involve any natural or logical relationships between ideas. His writing is like a brush fire which needs only a spark to start.

Many useful, stimulating, and even ingenious ideas can be obtained from the writings of the "Dumptruck." The ideas and information, however, must first be ferreted out and pieced together from the verbal rubble. The "Dumptruck" writer would respond to the question in this manner:

> "The selection of plant sites is a real problem. Back in 1936 while I was working for Consolidated Steel we were putting up a branch plant. I remember that our biggest headache was transportation of materials. And then our processes were pretty unique so we had to have specially machined installations. This is something you might consider in your early planning stages. Get your equipment set up right. It will save a lot of trouble later, etc."

Package Your Ideas. As direct consumers we would find it very awkward if we had to buy steel by the ton, wheat by the bushel, or milk by the cow. Similarly, the average person is unable to read the *Congressional Record* daily. In order to make commodities and information convenient for direct use they must be processed, and in taking them to market, an appropriate "package" is needed. This holds true for our everyday writing—it must be processed with thought and packaged in idea units of the size needed for direct consumption.

We might consider good written communication to be like playing "catch" with a ball. The writing should be solid and rounded without loopholes or sharp edges. The size of the ball (the written package) should make handling easy. The receiver's attention must be attracted so that the ball will be caught and the writer must be ready to catch the ball in return.

Conclusion. A problem in written communication is that often our words take on a character entirely unrelated to their intended meaning. The meaning of these wayward words diverges in the gaps between writer and writing, or writing and reader. We have to look between the lines, therefore, to determine whether something is "lost in translation."

In thinking about written communication we come to 3 conclusions:

1. Effective writing requires conscious effort

2. Putting words together is an individual and personal process.

3. Writing involves a dynamic interaction between writer and reader.

In evaluating our writing we asked ourselves these questions.

1. What do I want to say?

2. Does my writing say it clearly?

3. Are my thoughts presented in a form most acceptable to my reader?

We can compare our writing in terms of the extreme styles used by the: Dictator, Educator, Hourglass and Dumptruck.

Finally, we must package writing in a form acceptable to the reader. Rounding out this package cuts down friction and enables our writing to "roll" and acquire momentum. Written communication is like a ball. Here, catch! —**The End**

About the Author

B. J. Wachter is a staff engineer with National Aluminate Corp., Chicago, where he develops and promotes de-scaling chemicals and distributor products. With Nalco for seven years, he has worked on technical service of water treatment chemicals, particularly for boiler feed use. Before assuming his present duties, he was manager of technical service, marine boiler feedwater. Wachter has a B.A. degree in chemistry from Pennsylvania State University, and was a graduate research assistant at the University of Pittsburgh, 1950-51. He studied creative writing and marketing at Mexico City College and at Northwestern and Chicago Universities.

How to do it

PIPE LINE HINTS

$10 is paid for each illustrated acceptable contribution. Mail to The Editor, PIPE LINE INDUSTRY, P. O. Box 2608, Houston 1, Texas

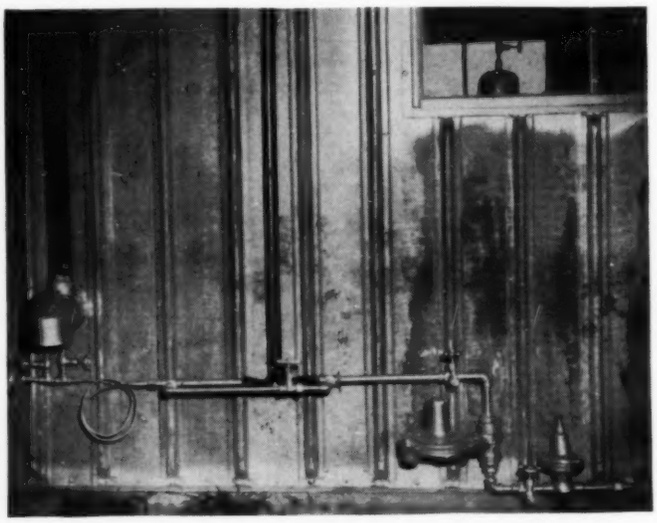
Lock Inside Tool House Door Prevents Tampering

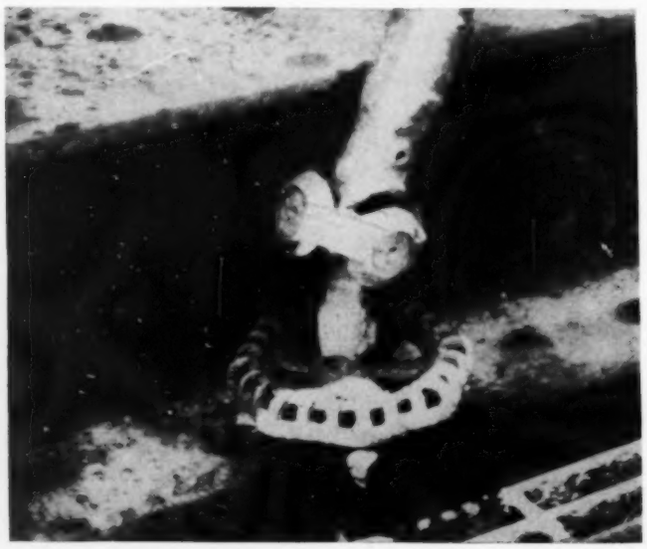
On portable tool boxes and houses, the lock can be placed inside a porthole in the door out of the weather and out of the reach of persons who would try to break in. Instead of placing the latch-bar on the outside of the door, it is placed on the inside so that it catches the edge of the doorway; then the hasp matches a hole in the locking hasp so that the lock hangs just inside the porthole. The outside of the hole is covered with a swinging plate so that it can easily be swung open and the lock opened, yet the lock is out of the weather and out of the reach of a thief's cutters.

Thermostat Inside Controls Outside Burner Fuel Supply

Where it is necessary to heat a regulator and meter station during cold winter months, a simple arrangement for using the minimum gas and keeping the apparatus safe is shown.

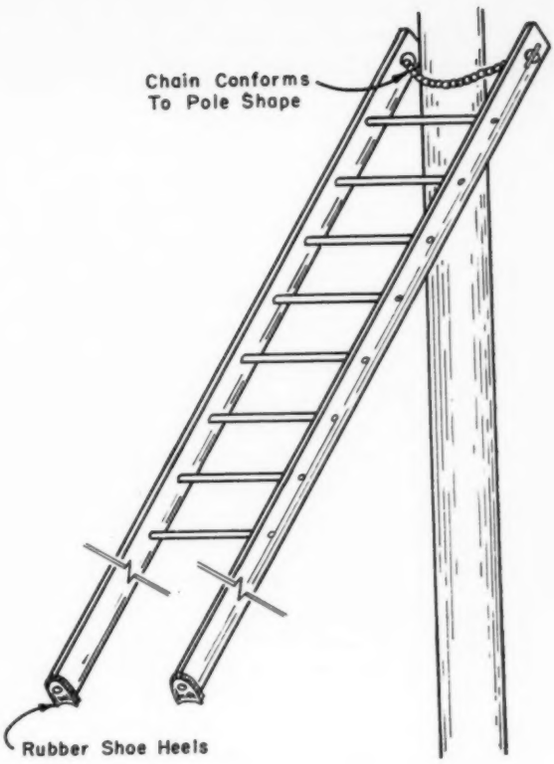
Gas supply enters at the right and a bypass goes to a thermostat, located on the downstream side of the regulator, and back to the burners which are placed outside the station. When temperature reaches point where hydrates form, the gas is turned on sufficiently enough to prevent freezing; everything is outside the meter house except the heat from the gas burner which surrounds the pipe on the upstream side of the regulator.





Old Universal Joint Aids In Operating Hidden Valves

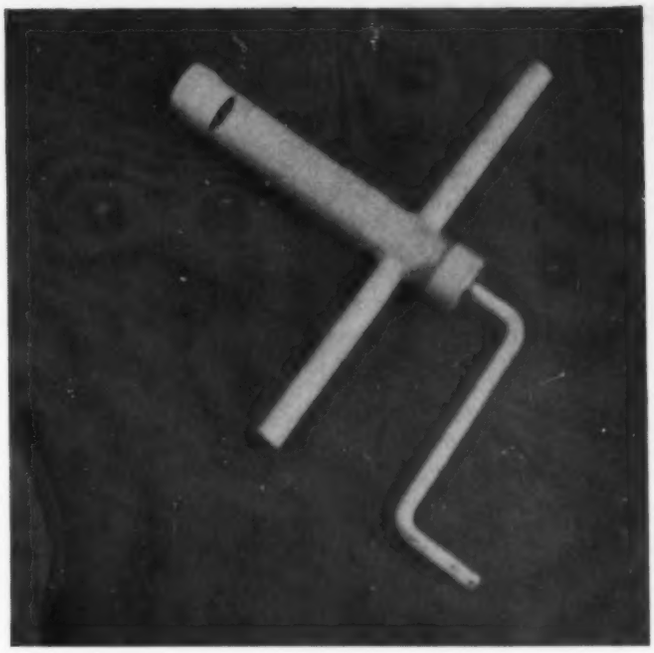
Where it is necessary to operate valves from a walkway which is not directly over the valve, a universal joint from a junked car will serve to change the direction of force. It is welded to the end of the bar and then a square is welded on which fits the nut on the top of the valve stem. The threads are then bradded down somewhat on the top of the valve stem and the squared end applied. This allows the valve to be easily operated from any point within several feet of being directly over the valve.



Chain, Rubber Heels Make Ladder Safe at Both Ends

Here's an easy way to make a ladder safe when working on trees or slick poles. Cut out the top rung and drill out the holes where the top rung fits into the sides. Then insert a piece of chain in place of the top rung. The chain will conform to the shape of a power or telephone pole or a tree, preventing twisting and slipping.

Put a pair of old rubber shoe heels on the bottom ends of the ladder's legs, beveled at the desired angle, to prevent the ladder from slipping on smooth surfaces.



Two-Way Wrench Solves Valve Opening Hazard

A West Texas pipeliner designed this wrench to overcome a valve opening hazard when inserting grease plugs on 1-inch valves used on drips. Grease plugs with 7/8-inch head were removed with speed handle wrench, but sometimes it took another wrench to keep the 1-inch valve closed to prevent leaks. This sometimes required two men to do the job.

The special wrench consists of a 1-inch wrench with a 7/8-inch socket inside the body of the wrench. Also a 5/8-inch socket is located within the 7/8-inch socket for use on 5/8-inch plugs.

The 1-inch wrench fits the valve plug to open and close the valve. The inside socket is set to fit the 7/8-inch plug; when 5/8-inch is needed, the operator just pushes down on the speed handle to insert the 5/8-inch socket which is held by a spring on the inside of the body on the handle.

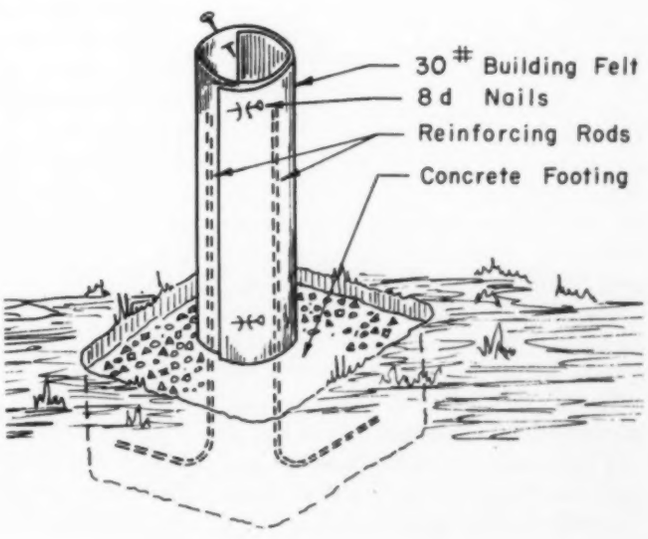
Now one man can do the job—quicker and easier.

Cylindrical Pier Form Made From Piece of 30-Pound Felt

In the absence of suitable form materials, a good cylindrical pier form can be fabricated from a piece of 30-pound building felt.

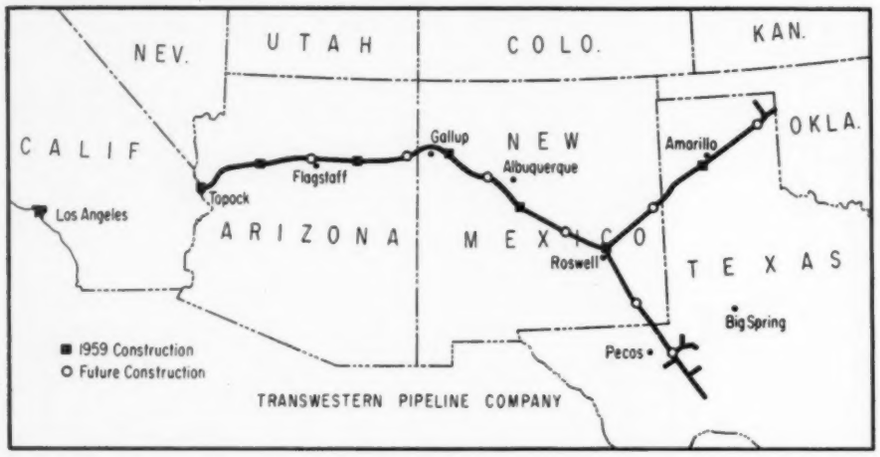
Roll the felt into a circle of the proper diameter, fastening the laps with nails used as pins, and place over the previously set footing and reinforcing rods.

When poured to the proper level the weight of the wet concrete will form a true cylinder. A nail pushed through the felt "form" at the desired height will show how much concrete to pour.



WHAT'S HAPPENING IN PIPE LINE CONSTRUCTION

By Donald G. DePugh, Construction Editor



Construction Underway on Transwestern; Completion Scheduled for Summer 1960

Construction is under way on Transwestern Pipeline Company's 1,800-mile Texas to California gas system. The transmission company hopes to complete the line by mid-1960 for delivery of gas to Pacific Lighting Gas Supply Company.

Four contractors have spreads on the 1,305-mile main line and 500 miles of laterals and gathering lines. Houston Contracting Company and H. C. Price Company are prime contractors and will build the main portion of the system. R. H. Fulton & Company and Western Pipe Line, Inc., will lay part of the line as subcontractors.

Houston Contracting is constructing about 600 miles of 20-, 24- and 30-inch in Texas and New Mexico. H. C. Price is building approximately 560 miles of 20-, 24- and 30-inch in New Mexico and Arizona. Houston's spreads include 149 miles, 30-inch, from Corona to McCartys, N. M.; 55 miles, 30-inch, Corona to Roswell, N. M.; 89 miles, 24-inch, Roswell to Carlsbad, N. M.; 61 miles, 20-inch, and 76 miles, 24-inch, Fort Stockton, Texas, to Carlsbad; and 166 miles of 24-inch from Roswell northeast to Dawn, Texas.

R. H. Fulton & Company and Western will construct 300 miles of 10-, 12- and 16-inch trunk lateral lines in Texas-Oklahoma and West Texas-New Mexico area.

Transwestern's $192 million project includes initial horsepower installation of 40,890 hp in six stations. Mid-Valley, Inc., will construct the stations at Amarillo, Texas; Roswell, Scholle and a point east of Gallup, N. M.; near Winslow and Seligman, Ariz.

Initial deliveries to Pacific Lighting will be 350 MMcf of gas per day; ultimate capacity is expected to be about 640 MMcf with a total of 125,000 compressor horsepower.

Transco Given Examiner Approval for 1959 Work

An FPC presiding examiner recommended that Transcontinental Gas Pipe Line Corporation receive authorization on its $53 million 1959 construction program.

Transco's proposal includes approximately 129 miles of 30- and 36-inch main line loops paralleling sections of the system in Texas, Louisiana, Alabama, Georgia, North Carolina, Virginia, Pennsylvania and New Jersey. It also includes about 53 miles of purchase laterals and additional compressor capacity.

The company's 1960 program, which includes facilities to cost over $60 million, was not authorized by the examiner.

The new facilities will enable Transco to increase its system capacity by 157 MMcf of gas daily.

Texas Eastern Completes Mont Belvieu Storage Well

Texas Eastern Transmission Corporation has completed its first LPG underground storage well at its Mont Belvieu, Texas, terminal.

Initial injection of propane was started in October. The well has a capacity of 329,000 barrels, but will be expanded to 1-million barrel capacity. Two other storage wells will be drilled at the salt dome with capacities of 1-million barrels each. The Little Big Inch will help eliminate summertime excess and wintertime shortages of propane.

In conjunction with the storage facilities, Texas Eastern has completed a 10-mile, 12-inch pipe line from Baytown to the terminal and installed two 700-horsepower centrifugal injection units. Two 100 hp pumps, used to pump water into the well displacing propane, and a 3,500 foot, 16-inch water line are under construction.

Alaska Gas Line Planned From Kenai to Anchorage

Anchorage Gas Corporation plans to construct a 165-mile, 12-inch gas line from Kenai to Anchorage. The $12 to $15 million project will include gathering lines and dehydration facilities.

Gas will be taken from Union Oil Company of California and Ohio Oil Company. Construction is scheduled to begin next spring.

Presiding Examiner Approves Three Gas Pipe Line Projects

An FPC examiner approved applications by three companies to construct facilities to take gas from Texas fields. Pioneer Gathering Systems, Inc.'s, project costing $3.5 million includes a system from Vinegarone field in Val Verde, Texas, to connect with Permian Basin Pipeline Company's line. Permian would build 84 miles, 16-inch, to take gas from Pioneer. El Paso Natural Gas Com-

pany was authorized to construct facilities costing $849,000.

Standard of California Plans Alaska Oil Line

Standard Oil Company of California has formulated plans for a 22-mile, 8-inch, crude line in Alaska. The line would extend from the Swanson River Unit field on the Kenai Peninsula to Nikiski on the Cook Inlet. Plans include a tanker terminal with a wharf for loading tankers and 240,000 barrels of storage capacity.

Construction should start this year and be completed next spring for operation by December, 1960.

Sam Carline Awarded Contract By Texas Gas Transmission

Sam Carline, Inc., will lay 20 miles, 12-inch for Texas Gas Transmission Company from Baldwin, La., toward the Gulf of Mexico.

Ohio Oil Co. Lets Contract To O. R. Burden Construction

O. E. Burden Construction Corporation has been awarded a contract to lay 60 miles, 8-inch products line for Ohio Oil Company. The line will run from Adrian to Samaria, Mich.

Columbia Gulf Transmission Lets Contract on Loop Line

Columbia Gulf Transmission Company has awarded a contract to Western Pipe Line Inc., for construction of 41 miles of 24-inch gas loop lines in Louisiana. The system will be looped between Lake Sand Junction to Arath Junction, La.

NATO Pipe Line Project Let to Italian Company

Compagnia Tecnica Internazionale (Techint) has been awarded contract to construct a 211-mile crude pipe line for NATO in Turkey. The 6-inch line runs between Malatya-Cetinkaya-Erzincan and will cost approximately $6 million.

Southern Natural Awards Work to C. S. LeNoir Co.

Southern Natural Gas Company has awarded contract to C. S. LeNoir Construction Company for 43 miles of 20-inch gas pipe lines in Alabama. This is part of Southern's major gas expansion program for 1959.

Viewing the "Unseen Journey"

The world premiere of Gulf Oil Corporation's 30-minute film, "Unseen Journey" was held at Houston's Majestic Theatre last month. The transportation movie, produced for Gulf's internal use and educational service, covers pipe line and barge transportation methods. In a different approach to industrial films, Gulf's stars are actual pipeliners in candid appearances.

Interprovincial Plans Additional Station Work

Interprovincial Pipe Line Company plans to add four new pump stations and install additional horsepower in several existing stations in 1960.

The $9.3 million project will include two new stations in Canada and two in the United States. Construction is expected to start next spring and be completed by the end of the year.

Fulton-Curran Joint Venture Working on Northern Natural

R. H. Fulton & Co. and Curren & Co. announced that they have joint venture on Northern Natural Gas Company construction work. Fulton & Curran has four main line spreads on loop lines and main line extensions. The contractors are laying 30-inch loops on the system between Texas and Minnesota; two spreads are on the Farmington to Duluth, Minn. 20- and 24-inch line and one on the 55-mile, 16-inch line to St. Cloud, Minn.

El Paso Natural Gas Lays 14 Miles, 16-Inch

El Paso Natural Gas Company is laying 14 miles of 16-inch gas line near Tempe, Ariz. Eastern Pipe Line Contractors is building the line.

Collins Completes Segment Of Kharg Island Oil Line

Collins Construction Company announces that its overseas company, International Marine Constructors, C.A., has completed the first "pull" of a 22-mile, 30-inch crude line in the Persian Gulf.

The 3-mile segment between Khargu Island and Kharg Island was completed October 18. The 19-mile section from Khargu Island to Gach Saran, Iran, will be completed in November. Iranian Oil Exploration & Producing Company is building the offshore line to its sea loading facilities under construction at Kharg Island.

Midwestern Gas Transmission Completes 350-Mile Pipe Line

Midwestern Gas Transmission Company has started moving gas through its 350-mile, 30-inch line from Portland, Tenn. to Joliet, Ill.

At Joliet the line ties in with Chicago District Pipeline Company's 50-mile, 36-inch conduit to Chicago.

PROPOSED PIPE LINE CONSTRUCTION

Here in convenient summary form is Pipe Line Industry's listing of company, line size, length, service, location and project status.

U. S.

Alaska Juneau Gold Mining Co., Los Angeles, 425 miles, 16-inch, gas, Oklahoma City area to St. Louis, planned.

Anchorage Gas Corp., Houston, 165 miles, 12-inch, gas, Kenai to Anchorage, Alaska, $15 million, planned.

Arkansas Industrial Pipeline Corp., Shreveport, 130 miles, 18-inch, gas, Perla-to-Helena, Ark., $9 million, planned.

Atlantic Seaboard Corp., Charleston, W. Va., 26-miles, 26 and 20-inch, gas, in West Virginia, Virginia and Maryland, contract let on 19 miles to H. L. Gentry Construction Co.

Carolina Pipeline Co., gas, main line, from near Aiken to Pontiac, S. C., $5 million, approved.

Coastal States Gas Producing Co., Corpus Christi, Texas, 289 miles, 14 and 18-inch main line and gathering system, McAllen to Falfurrias, Tex., area, and Lopena to La Salle County, $12 million, contract let on 200 miles to O. R. Burden Construction Corp.

60 miles, small diameter, gas gathering line, to tie in with system under construction and extend to Pearsall County, Texas, planned.

25 miles, gas, Associated Gas & Oil Co. field to South-Tex Corp., processing plant west of Corpus Christi, Texas, planned.

37 miles, gas gathering in Brown, Eastland, Comanche and Erath counties, Texas, planned.

Coastal Transmission Corp., Houston, compressor station additions and new lateral lines, $6.2 million, before FPC.

Colorado Interstate Gas Co., Colorado Springs, 140 miles, gas, Green River, Wyo.-to-Provo, Utah; 109 miles, 26-inch, Texas Panhandle to southeastern Colorado; 136 miles, 34-inch, southeastern Colorado-to-Pueblo, Colo.; 107 miles, 30-inch, Pueblo-to-Denver, $91 million, before FPC.

Colorado Oil & Gas Corp., Denver, 400-miles, gas, from Gubik field to Fairbanks, Alaska, planned.

Columbia Gulf Transmission Co., Houston, 12.8 miles, 6 and 20-inch, gas, loop line in Louisiana, $730,000, authorized.

41 miles, 24-inch, gas, loops, Lake Sand Junction to Arath Junction, La., contract let to Western Pipe Line, Inc.

East Coast Pipeline Co., 90 miles, 12- to 24-inch, products, Linden, N. J. to Suffolk County, N. Y., $25 million, planned.

El Paso Natural Gas Company, El Paso, 244 miles, 30-inch, Permian-San Juan loops, 108 miles, 20-inch, field feeder lines, before FPC.

69,240 hp in new and existing stations in Texas, Oklahoma, New Mexico and Utah, planned.

400 miles, 34-inch, Salt Lake City, Utah, to California border, before FPC.

Equitable Gas Company, Pittsburgh, Penn., 11.7 miles of storage pipe line and other facilities, $2,091,430, authorized.

12½-miles, 16-inch, paralleling existing system in Harrison and Marion counties, W. Va., authorized.

Florida Pipeline & Storage Co., 54 miles, products, Port Everglades to Homestead Air Force Base, Fla., planned.

Gillette Pipeline Co., Cheyenne, Wyo., 103 miles, crude, from Dead Horse Creek field to Casper, Wyo., planned.

Great Northern Railway, St. Paul, 400-600 miles, 12-20 inch, crude, from Williston Basin to St. Paul-Minneapolis and Duluth-Superior areas, considered.

Gulf Resources, New York, 125 miles, gas, gathering system, from Lopena area in Zapata County to a point in La Salle County, Texas, planned.

Hope Natural Gas Co., Clarksburg, W. Va., 45 miles, gas, from West Virginia to Pittsburgh area, planned, 20 miles, 24-inch, gas, in Wertzel and Monongalia counties, W. Va., authorized.

Humble Oil & Refining Company, Houston, 116 miles, gas, gathering various sizes, southwest Texas, contracts let on 57 miles to O. R. Burden Construction Corp. and H. B. Zachry Co.

Iron Ranges Natural Gas Co., 115 miles, gas, from Itasca and St. Louis counties along route of Mesabi range from Grand Rapids to Aurora, Minn., $5 million, FPC authorization.

60 miles from Duluth to Silver Bay, Minn., FPC authorization.

Michigan Wisconsin Pipe Line Co., Detroit, 311 miles, gas, Marshfield to Appleton, Wis., 66 miles, Illinois, Indiana, and Michigan, 5,280 hp station at Marshfield, $24 million, FPC authorization.

Midwestern Gas Transmission Co., Houston.

504 miles, 24-inch, gas, from Minnesota-Canada border near Winnipeg to Marshfield, Wis., $52 million, before FPC authorization.

Missouri-Kansas-Texas Railroad, 1400 miles LPG line, Midland, Texas, area to St. Paul-Minneapolis, Minn., and Madison; Wis., $55 million, planned.

Natural Gas Pipeline Company, Chicago, 29 miles, 10-inch lateral, in Oklahoma, before FPC.

Northern Natural Gas Company, Omaha.

171 miles, main line extensions, 66 miles, main loops, 139 miles, branch lines, 6,000 hp additions, to extend system from Minneapolis to Duluth-Superior area, $25.7 million, contracts let on 315 miles to Williams Bros. Co. and R. H. Fulton & Co.

46 miles, main line extensions, 191 miles, loops, 1,767 miles, branch lines, and 45,400 additional hp, in Iowa, Minnesota, South Dakota, Nebraska, Wisconsin and Illinois, $76.7 million, FPC authorization.

37 miles, 30-inch, Bushton compressor station to Otis field, Kansas, 7,000 additional hp at Bushton, and development of underground storage facilities at Otis field, $20 million, before FPC.

Ohio Fuel Gas Co., 59 miles, gas, 4-24-inch main lines, in Belmont, Carroll, Cuyahoga, Fairfield, Logan, Lorain, Marion, Muskingum, Stark and Wayne counties, Ohio, $5.1 million, planned.

Ohio Oil Company, 60 miles, 8-inch, products, Adrian to Samaria, Mich., contract let to O. R. Burden Construction Corp.

Pacific Gas & Electric Co., San Francisco, 296 miles, 36-inch, gas, from Klamath Falls, Ore., to Antioch, Calif., southern section of line from Canada to California, before California Public Utilities Commission.

131 miles, 34-inch, loops, Topock-Milpitas, before FPC.

42 miles, 30-inch, gas, Pittsburg to Irvington, Calif., planned.

Pacific Gas Transmission Co., San Francisco, 614 miles, 36-inch, Kingsgate B.C. to Klamath, Ore., northern section of Canada to California line, before FPC.

Pacific Lighting Gas Supply Co., 128-mile, 34-inch, gas, main line from Topock, Ariz. to Newberry, Calif., authorized.

Pacific Northwest Pipeline Corp., Salt Lake City, 100 miles gas, gathering lines **in San Juan Basin, Garmesa, Piceance** Creek, and Big Piney Fields, $3.5 **million, planned.**

59 miles, 16 and 20-inch, gas, from a point on main line near Camas, Wash., to Salem, Ore., $6.1 million, before FPC.

Permian Basin Pipeline Company, Omaha, 83 miles, 16-inch, gas, from Pioneer's proposed facilities to Spraberry, Texas, and 3,960 hp compressor station, $5 million, FPC examiner approval.

Piedmont Gas Co., Hickory, N. C., 78 miles, 2-8 inch, gas, from connection with Transcontinental Gas Pipe Line to serve customers in North Carolina, $2.6 million, authorized.

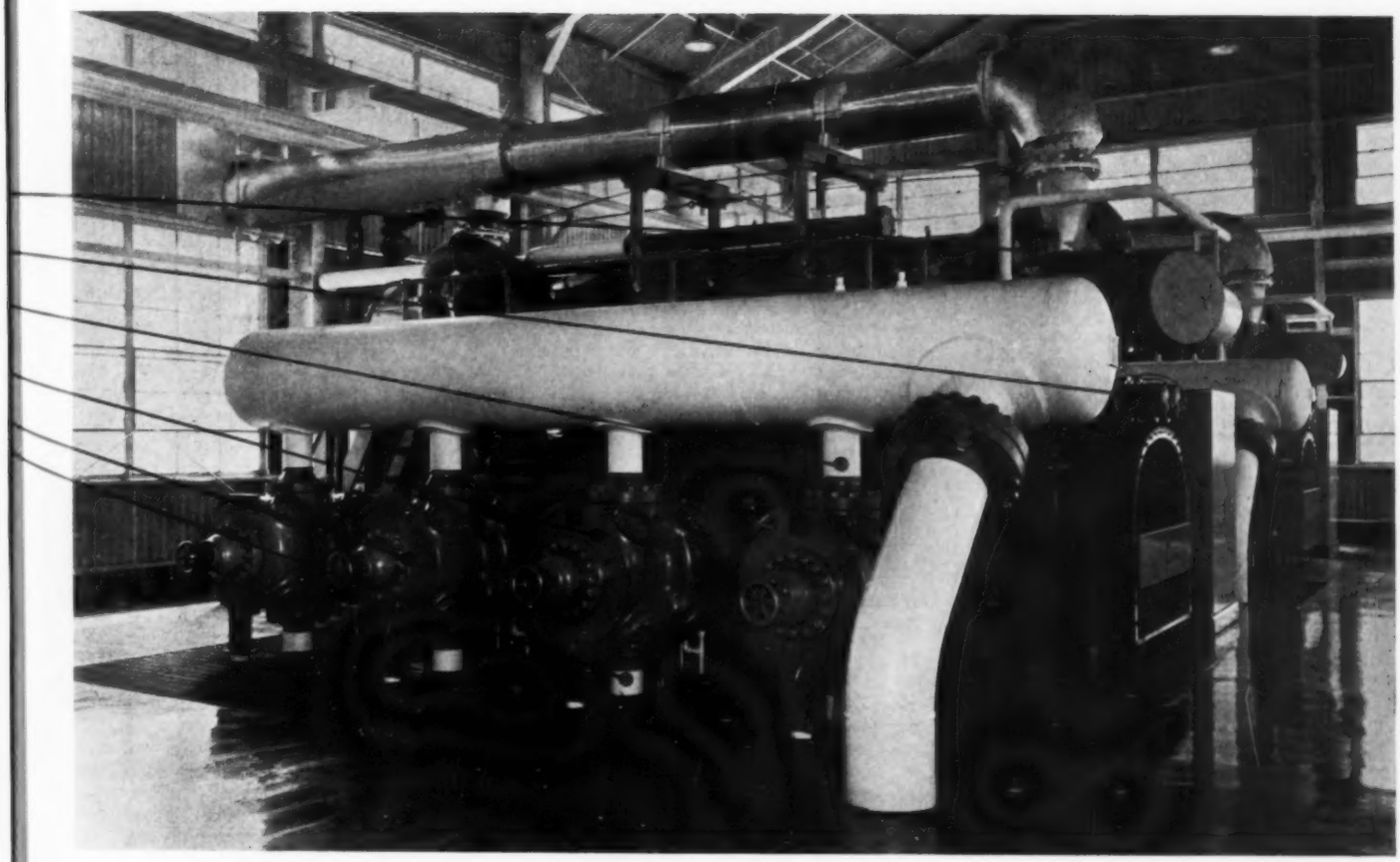
Pioneer Gathering System, Inc., Amarillo, Texas, pipe line facilities in Texas costing $3.7 million, FPC examiner approval.

Pioneer Natural Gas Co., Amarillo, Texas, 62 miles, 10-inch main, Pampa, Texas, to Canyon, in Randall County, Texas, 20 miles, small diameter, gathering, 4,000 h.p. stations, $4.5 million, planned.

Phillips Petroleum Co., 25 miles, 6 to 20-inch, gas, South Eunice, New Mexico area, planned.

(Continued on Page 88)

the tireless "attendant" compressor installations



With an Ingersoll-Rand Tendamatic control system, all phases of compressor startup, regulation, supervision and protection may now be executed automatically or by remote control. Thus the compressor plant is made independent and self-sustaining, and may be left to "think for itself".

On engine startup, all operations are performed in proper sequence and the unit is put on the line. During operation, engine and compressor are completely, *automatically* protected against any abnormal condition. On shutdown too, all operations are performed in sequence. In case of trouble, Tendamatic control gives warning, indicates the source, and if necessary, shuts down the unit.

These automatic control systems are the product of Ingersoll-Rand's Tendamatic Control Division—a specialized group of engineers and experienced production men whose job is the development, design, manufacture and application of control systems for all types of compressor installations. For more information, call your I-R representative or write for Form 3276.

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REDUCERS: Concentric and eccentric. Nominal pipe sizes 1" to 30", ASA B16.9, ASTM A234. Schedules 10 to 160, stainless steel, and other alloys. Special lengths and sizes.

SADDLES: Conventional, and for pressure vessel heads. Nozzle sizes from ¼" to 24". Fleet-Line saddles weld neatly into place in much less time, and with much less welding rod.

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PROPOSED CONSTRUCTION

continued

52 miles, 4 to 20-inch, gas, Gaines County, Texas, planned.

44-mile, 6-inch, products line, from Rocky pump stations to Amarillo, Texas, planned.

Rio Gas Gathering Co., San Antonio, 97 miles, 3 to 8-inch, gas gathering, South Texas, to supply gas to El Paso Natural Gas Company, planned.

Shamrock Oil & Gas Company, 49 miles, 20-inch, gas, Dumas to Amarillo, Texas, planned.

Southern California and Southern Counties Gas Cos., Los Angeles, 200 miles, 34-inch, from Nevada-California border to point near Fullerton, Calif., $44 million, before Public Utilities Commission.

Southern Natural Gas Company, Birmingham, 490 miles, 16-24-inch, loop lines, gas, between Gwinville, Miss., and Wrens Ga; 62 miles, 14-inch, loops, along Atlanta-Macon line; 53 miles, 6⅝ to 14-inch, loops, along various branch lines. 3,140 additional hp at Gallion and Elmore, Ala. and Wrens, Ga. 60 miles, 20-inch, loops, in Louisiana between Franklinton and White Castle and South of Toca. Lateral lines south of Gwinville and west to Cranfield field. 8,720 hp added at Franklinton, White Castle, Patterson and Brookhaven, contracts let on 442 miles to Sharman, Allen, Gay & Taylor; Oklahoma Contracting Co.; Harbert Construction Corp.; C. S. LeNoir Construction Co.; and Buchanan Contracting Co.

Standard Oil Company of California, 22 miles, 8-inch, crude, Kenai Peninsula to Nikiski, Alaska, $4 million, considered.

Tennessee Gas Pipeline Co., Houston, 21 miles, 16-inch, 2 miles, 12¾-inch, gas, Louisiana coast, Vermillion, Blocks 46 and 64, $2.9 million, before FPC.

158 miles, 36-inch, looping system in Louisiana and Mississippi, to supply Midwestern additional gas at Portland, Tenn., $61.4 million, authorized.

Texas Eastern Transmission Corp., Shreveport, La.

65 miles, gas, Delmont, Penn., to Lambertville, N. J., before FPC.

40 miles, Lambertvile to Linden, N. J., before FPC.

350 miles, 24-inch, coal slurry, West Virginia to New York, considered.

Texas Electric Service Company, Fort Worth, 300 miles, gas, Old Ocean field to Fort Worth, Texas, $25 million, considered.

Tensas Gas Gathering Corp., Shreveport, 36.6 miles, gas, gathering system in Rodney Field, Jefferson County, Miss. and from North and South Locust Ridge, Lake St. John Field in Tensas and Concordia parishes, La., $855,413, authorized.

Texas Illinois Gas Pipeline Company, Chicago, 16,000 additional hp to stations at Lufkin, and Marshall, Texas; Texarkana, Malvern, Searcy, and Biggers, Ark.; Jackson, Mo.; and Hammond. Ill., $3.9 million, FPC examiner approval.

371 miles, 30-inch, loops, and 45 miles, laterals, gas, 6,700 hp station in Victoria County, Texas, $43.5 million, before FPC.

Transcontinental Gas Pipe Line Corp., Houston. 149 miles, 36-inch, 80 miles, 30-inch, main loops, 34 miles, 20, 24-inch gathering, compressor stations at Nueces County, Texas and St. Helena Parish, La., additional hp in eight stations, $51 million, before FPC.

13 miles, 24-inch and 18 miles, 20-inch loops, Louisiana, FPC authorization. 14 miles, 16-inch laterals, 1-mile, 12-inch lateral, Louisiana, $2.1 million, FPC authorization.

Transwestern Pipeline Company, Houston, 1,305 miles, 24- and 30-inch, gas, main line, from West Texas and Oklahoma-Texas Panhandle area to Topock, Ariz., $193 million, FPC authorization. Contracts let to Houston Contracting Co., H. C. Price, R. H. Fulton & Co., and Western Pipe Line, Inc.

Underground Storage & Exploration, Upper Darby, Penn., 394 miles, 12-inch LPG, from Moundsville, W. Va. to Newark, N. J., $9 million, approved.

95 miles, 6-8 inch, laterals to Mauch Chunk, Penn., and to Philadelphia, planned.

Valley Gas Transmission, Inc., Houston, 160 miles, 3 to 8-inch, gas, gathering, in Hidalgo, Brooks, Starr and Jim Wells Counties, Texas, $15 million, before FPC.

Wilcox Crude Oil Corp., Shreveport, La., 20 miles, crude line in east central Louisiana, $500,000, planned.

International

ACT Oils, Ltd., Montreal, 400 miles, crude, Dawson Creek, B. C., to Bella Coola, B. C., before B. C. government.

Alaska-Yukon Refiners and Distributors, Ltd., Edmonton, Alta., 150 miles, products, serving Alaska and Yukon territory, $3.5 million, planned.

Alberta Gas Trunk Line Company, 386 miles, 26-36-inch, gas, main, Berland River area, Alberta, to Alberta-British Columbia border; and 235 miles, 8-18-inch, gas, gathering, Alberta, $100 million, Alberta Oil and Gas Conservation Board, approved.

Alberta Natural Gas Company (Jointly owned by Westcoast Transmission Co. and Alberta & Southern Gas Co. Ltd.) 110 miles, 36-inch, gas, Alberta border to British Columbia-Idaho border, supply gas to Pacific Gas & Electric Co., $40 million, planned.

Arab League Oil Committee, large diameter crude line from Persian Gulf to Mediterranean Coast, $500 million, considered.

Aurine Alps Railway & Pipeline, 200 miles, crude, Venice to Munich, Germany, considered.

Bituminous Oil Pipeline Co., Calgary, 250 miles, crude, from Athabasca tar sand plant in northeastern Alberta to Edmonton, approved.

(Continued on Page 92)

ACF Industries, Inc., W-K-M Div.
Aerotec Corp.
Aitken, M. N. Company
Aldrich Pump Co.
Allied Chemical, Plastics & Coal Chemical Division
Allis-Chalmers Mfg. Co.
Alston Mfg. Co.
American Blower Division American-Standard
American Cable Div. American Chain & Cable Co., Inc.
American Chain & Cable Co., Inc. R-P & C Valve Div.
American Cyanamid Co. Jefferson Chemical Co. Inc. Subsidiary
American-Marietta Co.
American-Standard, American Blower Division Norwood Controls Unit Detroit Controls
Anchor-Wate
Anderson, V. D. Co.
Andrews Tower, Inc.
Automatic Power Inc.

Barber-Greene
Beaird J. B. Co. Inc.
Bethlehem Steel Co. Supply Div.
Bettis Corp.
Bonney Forge & Tool Works
Borg-Warner Corp., Byron Jackson Div.
Bucyrus-Erie Co.
Buffalo-Eclipse Corp., Penberthy Mfg. Co. Div.
Byron Jackson Pumps Inc. Subsidiary of Borg-Warner Corp.

Carver-Stimpson Pipe Cleaning Co. Inc.
Caterpillar Tractor Co.
Cathodic Protection Service
Central Plastics Distributing Co.
Centrifix Corp.
Challenge Mfg. Co.
Chance, A. B. Co.
Charles Machine Works, Inc.
Chemetron Corp., Tube Turns Division
Cherokee Laboratories, Inc.
Clark Bros. Co., One of The Dresser Industries
Coffing Hoist Div., Duff-Norton Co.
Colorado Fuel & Iron Corp. Wickwire Spencer Steel Div.
Commercial Iron Works
Cooper-Bessemer Corp.
Corrosion Services Incorporated
Corrosion Rectifying Co., Inc.
Cotten, G. A. Co.
Crane Co.
Crose, M. J. Mfg. Co. Inc.
Crutcher, Rolfs, Cummings, Inc.

Darling Valve & Mfg. Co.
Day, S. D. Co.
Dresser Industries, Clark Bros. Co. Div. Magnet Cove Barium Corp. Div.
Duff-Norton Co., Coffing Hoist Div.
Dunlap Mfg. Co.
Duriron Co. Inc.
Dutch Brand Div., Johns-Manville Corp.

Edison, Thomas A. Industries, Instrument Division
Allan Edwards, Inc.
Elliott Co., Ridgway Division
Elsey Mfg. Co.
Ensign-Bickford Co.

Falk Corp.
Farrel-Birmingham Co., Inc.
Flexitallic Gasket Co.
Floor Products Co.
Fram Corp., Warner Lewis Co. Div.

These leading manufacturers, suppliers and service companies have filed complete or condensed catalog data in the current edition of the new PIPE LINE CATALOG. See their detailed information in the catalog when you are ready to buy.

Gardner-Denver Co.
Garrett Oil Tools, Inc., Division of U. S. Industries, Inc.
Gaso Pump & Burner Mfg. Co.
Gasoline Plant Construction Corp.
Gearench Mfg. Co.
General Descaling Co., Ltd.
General Electric Co., Apparatus Division
Gorman-Rupp Co.
Greenhead Sling & Supply Co.
Greenwood Valve Division Vernon Tool Co., Ltd.
Grove Valve & Regulator Co.

H & M Pipe Beveling Machine Co.
Hamer Valves, Inc.
Hercules Motors Corp.
Homelite, Division of Textron Inc.
Horton Equipment Co.
Hudson Engineering Corp.
Humble Oil & Refining Co.
Hydril Co.

Indus Corp.
Ingersoll-Rand
Instruments, Inc.

Jefferson Chemical Co., Subsidiary of American Cyanamid Co.
Johns-Manville Corp., Dutch Brand Div.

Kellogg, Communications Division of ITT
Kinzbach Tool Co., Inc.
Knudsen, Vic Co.

L & M Company
Ladish Company
Ledeen Mfg. Co.
Leland Equipment Co.
Lewis, Warner Co. Div. of Fram Corp.
Lloyd Metal Foundry

Magnet Cove Barium Corp. One of The Dresser Industries
Magnetrol, Inc.
Mallay Tool Service
Maloney, F. H. Co.
MAREP, S. N.
Marsh Instrument Co.
Mason-Neilan Div. of Worthington Corp.
Mathey, C. A. Machine Works, Inc.
Mavor-Kelly Company
McCord Corp.
McFarland Engineering & Pump Co.
McFarland Mfg. Corp.
McKissick Products Corp.
Mercoid Corp.
Midwestern Manufacturing Co.
Midwestern Pipe Line Products Co.
Mine Safety Appliances Co.
Mixing Equipment Co., Inc.
Morris-Young-Owens Co.
Murphy, Frank W. Mfr. Inc.

National Tank Co.
Naylor Pipe Co.
Nickles Machine Corp.
Norwood Controls Unit, Detroit Controls Division of American-Standard

Oil Well Supply Div. of U. S. Steel

Peerless Mfg. Co.
Pelican Supply Co., Inc.
Penberthy Mfg. Co., Division of Buffalo-Eclipse Corp.
Perrault Equipment Co.
Petrolite Corp., Tretolite Co. Div.
Philco Corp., Government & Indus. Div.
Philip Carey Mfg. Co.
Pipe Line Development Co.
Pittsburgh-Des Moines Steel Co
Plastics & Coal Chemicals Division of Allied Chemical
Portable Bridge & Equipment Co.
Pottermeter Co., Division of Potter Aeronautical Corp.
Protecto Wrap Co.

Quality March Equipment Co., Inc.

R-P & C Valve Div., American Chain & Cable
Ramsey Winch Mfg. Co.
Ray-Test Engineers, Inc.
Reilly Tar & Chemical Corp.
Remco Manufacturing Co.
Ridgway Div., Elliott Co.
Rig Engineers & Fabricators Co., Inc.
Riggs, Wm. L. Co.
Robishaw Engineering Inc.
Rochester Manufacturing Co., Inc.
Rolo Manufacturing Co.
Ruberoid Co.

Shafer Valve Co.
Skinner, M. B. Co.
Sooner Boomer Mfg. Div.
Southern Mill & Mfg. Co.
Sprague Engineering Corp.
Standard Magnesium Corp.
Staytite Co.
Stearns, D. E. Co.
Stearns, N. C. Co.
Steel Forgings, Inc.
Stewarts & Lloyds Ltd.
Superior Equipment Co.
Sewco, Inc.

Textron, Inc., Homelite Division
Thermix Corp.
Thornhill-Craver Co., Inc.
Tinker & Rasor
Tretolite Co. Div. of Petrolite Corp.
Tube Turns Div. of Chemetron Corp.

Union Switch & Signal Div. of Westinghouse Air Brake Co.
U. S. Industries, Inc., Garrett Oil Tools, Inc. Division
United States Motors Corp.
United States Steel Corp., Oil Well Supply Division
Universal Oil Products Co.

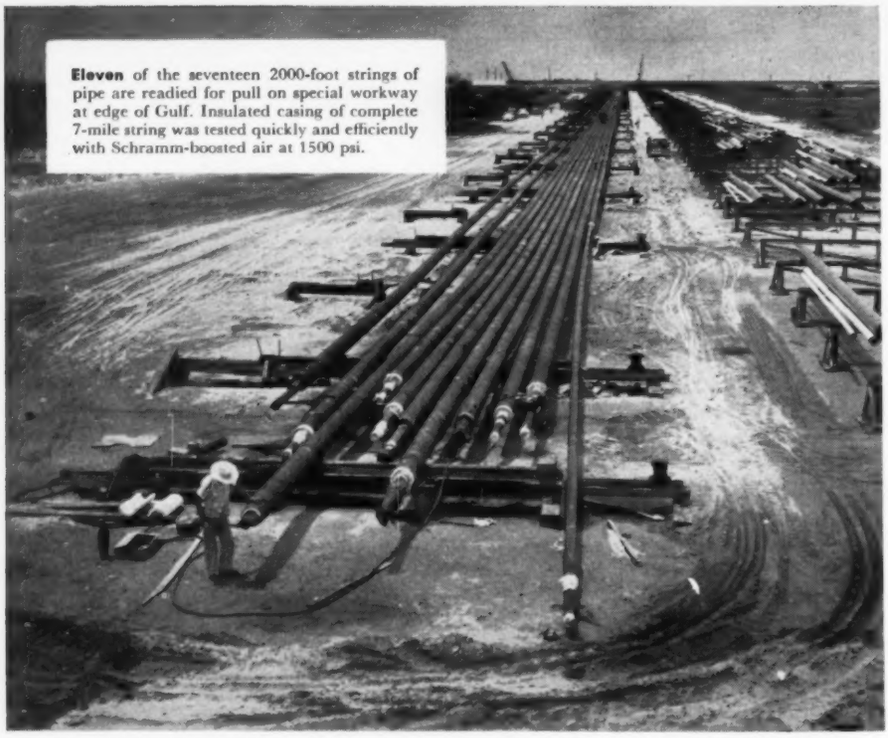
Vereinigte Armaturen-Gessellschaft MBH
Vernon Tool Co., Ltd. Greenwood Valve Division
Voss, J. H. H. Co., Inc.

W-K-M Div. of ACF Industries, Inc.
Wachs, E. H. Co.
Waldron, John Corp.
Waukesha Motor Co.
Westinghouse Air Brake Co., Union Switch & Signal Division
White Diesel Engine Division The White Motor Co.
Whitmore Homebuilders, Inc.
Wickwire Spencer Steel Division The Colorado Fuel & Iron Corp.
Wilkinson Products Co.
Williamson, T. D. Inc.
Worthington Corp.
Worthington Corp., Mason-Neilan Division

Yale Machine Works

Zeligson Truck & Equipment Co.

PIPE LINE CATALOG



Eleven of the seventeen 2000-foot strings of pipe are readied for pull on special workway at edge of Gulf. Insulated casing of complete 7-mile string was tested quickly and efficiently with Schramm-boosted air at 1500 psi.

SCHRAMM-BOOSTED AIR MAKES PNEUMATIC TESTING PRACTICAL!

Schramm tests Freeport's 7-mile pipe line with compressed air!

Now, from the Freeport Sulphur Company's huge 7-mile under-water pipe line . . . more proof of how fast and easily you can test pipe lines, using compressed air from Schramm equipment. This newsmaking pipe line is a complicated 3-in-1 job: a 6-inch molten sulfur carrier, jacketed by a 7⅝-inch hot water line insulated and rolled into a 14-inch casing. After the line was pulled into place the complete length of the 14-inch casing was tested to 1500 psi in 39 hours with Schramm pipe line testing service. At the start, air was supplied by a Schramm 125 cfm Compressor, for velocity control to protect insulation on the 7⅝-inch pipe. Talk about a "clean" job in your operations! Schramm equipment rolls to your test site on tractor trailers, eliminates problems of water supply and disposal, weather factors, uneven pressures and delays in draining lines. Get details on Schramm savings today!

See the Yellow Pages for local Sales, Service and Rentals of Schramm Air Compressors.

Schramm equipment is easily moved to any location. Lines are ready for use the instant testing is completed.

Buy or rent. Schramm offers a complete package: three Schramm 600 cfm Portable Compressors (*rear units*), two 1-D Booster Units (*center*), and one PPC Booster Unit. Rental includes delivery to site, complete operating team.

Schramm, Inc.

MANUFACTURERS OF AIR COMPRESSORS

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PROPOSED CONSTRUCTION

continued

Burmah Oil Co., Ltd., 850 miles, crude, 20 inch, from Nahorkatiya to Calcutta, India.

Cartier Gas Corp. (St. Maurice Gas, Inc., and Consumers Gas Co., Toronto), 170 miles, gas, Montreal to Quebec City, planned.

Consolidated Gathering Systems, Ltd., Calgary, 198 miles, crude, Sturgeon field to Edmonton, planned.

Creole Petroleum Co., 44 miles, 12-30-inch, gas, Bachaquero to Tia Juana, Venezuela, planned.

Development and Resources Corp., 70 miles, 8 inch, gas, from Agha Jari oil field to Ahwaz, Iran, planned.

Entre Nazionali Idrocarburi, Rome, Italy, crude, from Qum field in Iran to the Mediterranean Sea, considered.

Foothills Pipe Line, Ltd., 500 miles, 12 to 16-inch, LPG, from Alberta to Pacific Coast, $80 million, considered.

Gibson Crude Oil Purchasing Co. Ltd., 170 miles, crude, Milligan Creek, B. C. to Grande Prairie, Alta., planned.

Hydrocarbons Pipeline, Ltd., Winnipeg, Manitoba, 880 miles, 6-8 inch, products, from Edmonton to Winnipeg, $35 million, partial authorization.

Independent Pipe Line Co., 2,019 miles, 34-36-inch, crude, Edmonton to Montreal, 23,000 pump horsepower, $395 million, before Borden Commission.

Interprovincial Pipe Line Company, 350-mile extension from Toronto to Montreal, looping line from Edmonton to Toronto, crude, $240 million, considered.

Additional horsepower in four new stations and several existing stations, $9.3 million, planned.

Island Transmission Company Limited, Nanaimo, B.C., 25 miles, 10-inch, gas, from point near Vancouver, B.C. to Vancouver Island, 67 miles, 10-inch, laterals to Victoria and Nanaimo, B.C., $14 million, planned.

Mid-Continent Pipe Lines, Ltd., 1500-mile, 30-inch crude, Edmonton to Chicago, planned.

NATO, 211 miles, crude, 6-inch, between Malatya-Cetinkaya-Erzincan, Turkey, $6 million, contract let to Compagnia Technica Internazionale.

National Iranian Oil Co., 146 miles, 6 inch, crude, from Azna to Isfahan, Iran, $5 million, planned.

1000 miles, 38 inch, crude, from central Iran to the Turkish Mediterranean coast, considered.

500 miles, 8-inch, products, Teheran to Meshed, Iran, contract let on 250 miles to Williams Bros. Co.

Pacific Petroleums Ltd., 213 miles, 3-8-inch, crude, gathering, Milligan Creek and Blueberry fields to Dawson Creek, planned.

(Continued on Page 96)

off for Southern Pacific Pipe Lines

Push a button in Los Angeles

and four pump stations throb into action out on the desert over 600 miles away

Union Switch & Signal equipment controls operating sequence and telemeters operation of 33,000 bbl/day products line

FLEXIBILITY and fail-safe operation are the keynotes of the new pipeline system operated by Southern Pacific Pipe Lines, Inc. The line is used to transport refined products such as gasoline, jet fuel, diesel oil, etc., from El Paso, Texas, to Tucson and Phoenix, Arizona. All Centralized Transport Control equipment for four unattended booster stations was supplied by Union Switch & Signal.

REMOTE or LOCAL: All four booster stations are normally controlled from Los Angeles. Any station can be controlled locally, when desired. In any case, continuous pressure and suction readings are displayed on the console at Los Angeles and automatically recorded every fifteen minutes by an automatic typewriter. Any malfunction, at any point in the system, is indicated on the console. The equipment affected is shut down automatically and cannot be started again until the trouble has been cleared.

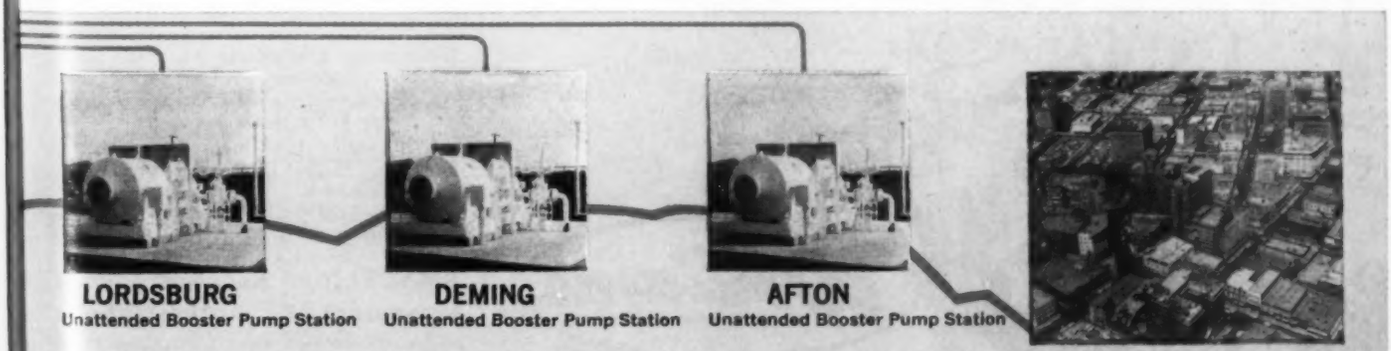
COMMUNICATION: Four telegraphic-type communications lines, owned by Southern Pacific, are used to transmit control codes to the stations and telemetered information back to Los Angeles. Each line serves one station. An additional commercial communications line serves as a stand-by for all four stations. Signals are coded to prevent noise or interference from causing faulty operation or indication.

MAXIMUM EFFICIENCY: The Centralized Control system, designed and installed by Union Switch & Signal Division of Westinghouse Air Brake Company, cuts down the chance for expensive error. It keeps the Southern Pacific Scheduling Department in Los Angeles informed, at all times, of exactly what is happening in the field. It speeds operation, adds security and reliability.

Union Switch & Signal has designed many successful custom systems for pipeline companies. And now out of that experience, it has developed standardized central control systems that cut costs, add flexibility, and save space, as well as making pipeline control extremely reliable.

"Pioneers in Push-Button Science"

UNION SWITCH & SIGNAL
DIVISION OF WESTINGHOUSE AIR BRAKE COMPANY
PITTSBURGH 18, PENNSYLVANIA



LORDSBURG
Unattended Booster Pump Station

DEMING
Unattended Booster Pump Station

AFTON
Unattended Booster Pump Station

EL PASO
Input Terminal

LOCAL CONTROL—Operation also can be controlled automatically at the pump station. Or the station can be run manually. The choice is up to the local station. But Los Angeles always knows which mode of control is being used and always receives a continuous flow of system information.

THE FUTURE—Southern Pacific Pipe Lines, Inc. can already see opportunity to make this system more automatic and more efficient. They plan, in time, to be able to let stations adjust automatically to proper unit operation when an upstream or downstream station goes off the line.

PROPOSED CONSTRUCTION
continued

Palestine Economic Corp., New York, 135 miles, 16-inch, crude, Eilat to Beersheba, Israel, to be completed July 1960.

Peace River Oil Pipe Line Co., Ltd., 70-mile, crude, Swan Hills to Iosegun Junction, approved.

230 miles, 8-inch, crude gathering, from fields in northeast British Columbia to Dawson Creek, B. C., and Grande Prairie, Alta., and to existing lines at Sturgeon Lake, $8.5 million, planned.

Pembina Pipe Line, Ltd., Edmonton, 1,200 miles, LPG, from Alberta gas fields to eastern Canada, planned.

Petroleos Mexicanos, 38 miles, 4 inch, products, from Mexico City to Toluca, $500,000 planned.

126 miles, 4, 6 and 8 inch, products, from Mexico City to Cuernavaca and Puebla, $2.5 million, planned.

214 miles, products, Monterrey to Torreon, $6.5 million, planned.

Pipelines of Puerto Rico, Inc., 95 miles, 8-inch, products, Penuelas to San Juan, Puerto Rico, planned.

Producers Pipelines Ltd., 25 miles, 4-inch, crude, Arlington Manor pool to Parkman pool, Saskatchewan, planned.

Rangeland Pipe Line Company Limited, 111 miles, 8-inch, crude, southeastern Alberta to Calgary, $3 million, planned.

Sociedad Nacional de Oleoductor, 75 miles, crude, from Santiago-to-Valparaiso, $3 million, planned.

Societa Nazionale Metanodotti, 650 miles, 18-inch, crude, Genoa, to Milan-Cremona-Torino, Italy, and Aigle, Switzerland, with extensions to Karlsruhe and Munich, Germany, planned.

Societe d'Etude du Pipe Line Sud-European, Paris, 419 miles, 30-inch, crude, port of Lavera to Strasbourg, with lateral extending 40 miles to Karlsruhe, Germany, approved by French cabinet.

Standard-Vacuum Oil Company, 60 miles, 8-inch, gas, main, in South Sumatra, considered.

Ste. d-Etudes de Pipeline Intercontinetaux, Paris, 1,400 miles, 30-40-inch, gas, from Hassi R'Mel field in central Algeria across Mediterranean, through Spain, France and into West Germany, considered, Fish International Corporation making engineering and feasibility studies.

Sui Gas Transmission Co., Multan, Punjab, India, 145 miles, 8-inch, gas, from Sylhet to Dacca, East Pakistan, $9 million, considered.

130 miles, 16-inch, gas, main line, Multan to Lyallpur, planned.

Trans-Canada Pipe Lines Limited, Toronto, compressor stations at Ignace, Geraldton and Hearst, Northern Ontario, and Maple, north of Toronto, $15.5 million, planned.

Trans-Prairie Pipelines, Ltd., Edmonton, crude line, from Weyburn field to Regina-Moose Jaw areas, $5 million, considered.

Crude line from Milligan Creek area to Dawson Creek and Fort St. John refineries, planned.

Union Gas Company of Canada Limited, 45 miles, 8-inch, gas, main, Stratford to Goderich, Ontario; 10-miles, 8-inch, main, to Amhertburg; 10-miles, 12-inch, lateral, Galt to Brantford, planned.

Westcoast Transmission Company, Ltd., 250 miles, 30-inch, gas, Taylor to Fort Nelson, B. C., planned.

Williams-McWilliams Industries, Inc., New York, 441 miles, 6-inch, crude, Villa Montes, Bolivia to Villa Hayes, Paraguay, considered.

Yacimientos Petroliferos Fiscales, Buenos Aires, Argentina, 621 miles, 12-inch, products, Mendoza to San Lorenzo, Argentina, $19 million, planned.

281 miles, 12¾ inch, crude, Pichanal to San Miguel Tucuman to Techint, S. A., planned.

450 miles, 16-inch, crude, from Neuquen Province to Bahia Blanca, planned.

Texas Eastern Receives Temporary FPC Authorization

The Federal Power Commission has granted Texas Eastern Transmission Corporation temporary authorization to construct a 7,500 horsepower compressor station at Longview, Texas.

The $2.5 million station will compensate for a reduction in delivery pressure of gas from United Gas Pipe Line Company into Texas Eastern's system near Longview.

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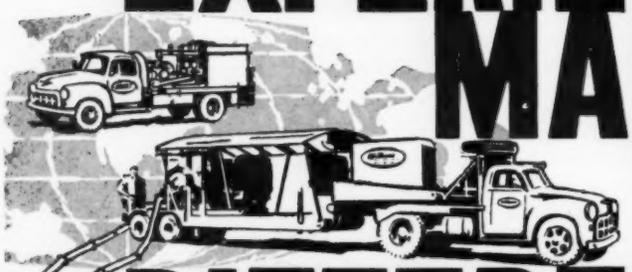

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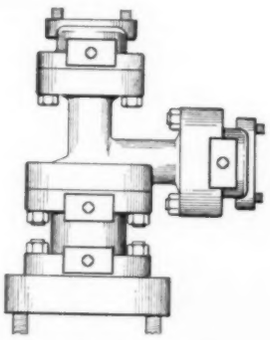
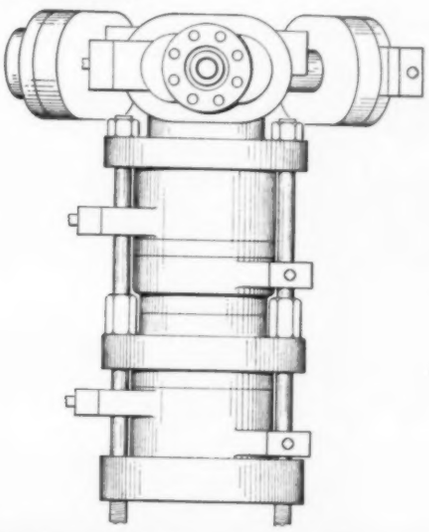
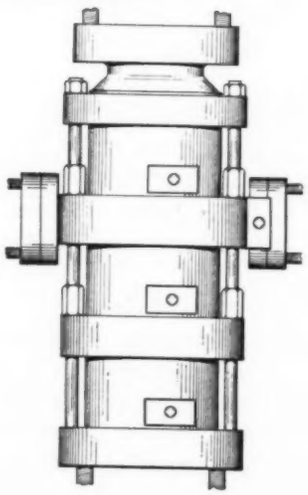


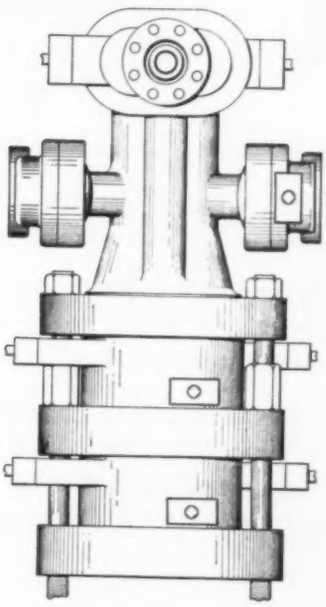
Triple Completion



Dual Completion



Quadruple Completion



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For more data on advertised products, use Readers' Service Cards, last page.

ON THE LINE

Welders Association

The Welders Association of America has been formed in Odessa, Texas. Executive vice president, Woodie Fox, stated the main functions would be education and public relations. The association is intended to establish the welder in the public eye as an important businessman and to offer him public recognition as a craftsman on equal basis as other trades.

Equipment Demonstrated on TV

An hour-long television program, presented by IBM's data processing division, was seen by business men in 92 cities on a closed circuit telecast program featuring new equipment.

Among items demonstrated was the new 1,401 data processing system, the latest addition to solid-state equipment. The 1,401 makes available in machine accounting equipment features previously found in larger, more costly computer systems. One of the features of the 1,401 is a new printing principle in which a chain moves swiftly in a horizontal plane across the face of the documents to be printed. Aligned behind the paper is a row of 132 hammers—one for each position which can be printed on a line. Under electronic control, groups of hammers strike the paper and a vertically moving inked ribbon against the appropriate characters which are attached to the chain. The impact imprints material at the rate of 600 lines a minute.

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Of a Different Name

Changing the company name from Magnolia Petroleum Company to Mobil Oil Company sounds simple doesn't it? Well it was, except for a few minor details—such as:

1) Mailing over 250,000 letters and notices 2) altering about 15,000,000 copies of individual stationery forms with the aid of 2,000 rubber stamps. 3) approximately 5,000 Magnolia service station signs were replaced with "Mobil" emblems, 4) more than 25,000 other signs changed, and 6) 2,000 car and truck titles transferred.

A five-man "Name Change Task Group" worked for nearly two months changing the company name on everything from bank accounts to credit cards.

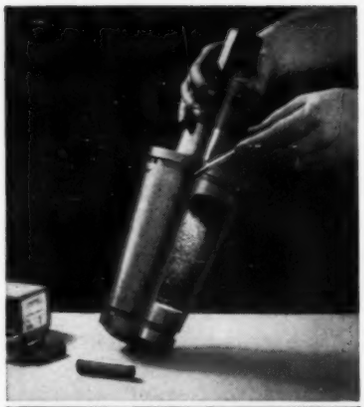
The final legal move in the switch was filing of a certificate with the state governments in each of the 18 states in which Mobil now operates.

The flying red horse remains intact —it's just a horse of a different name.

Education Boost

Tennessee Gas Transmission Company has proposed a new program to financially aid colleges and universities. The Tennessee Gas Foundation will equal contributions by its employes to eligible schools.

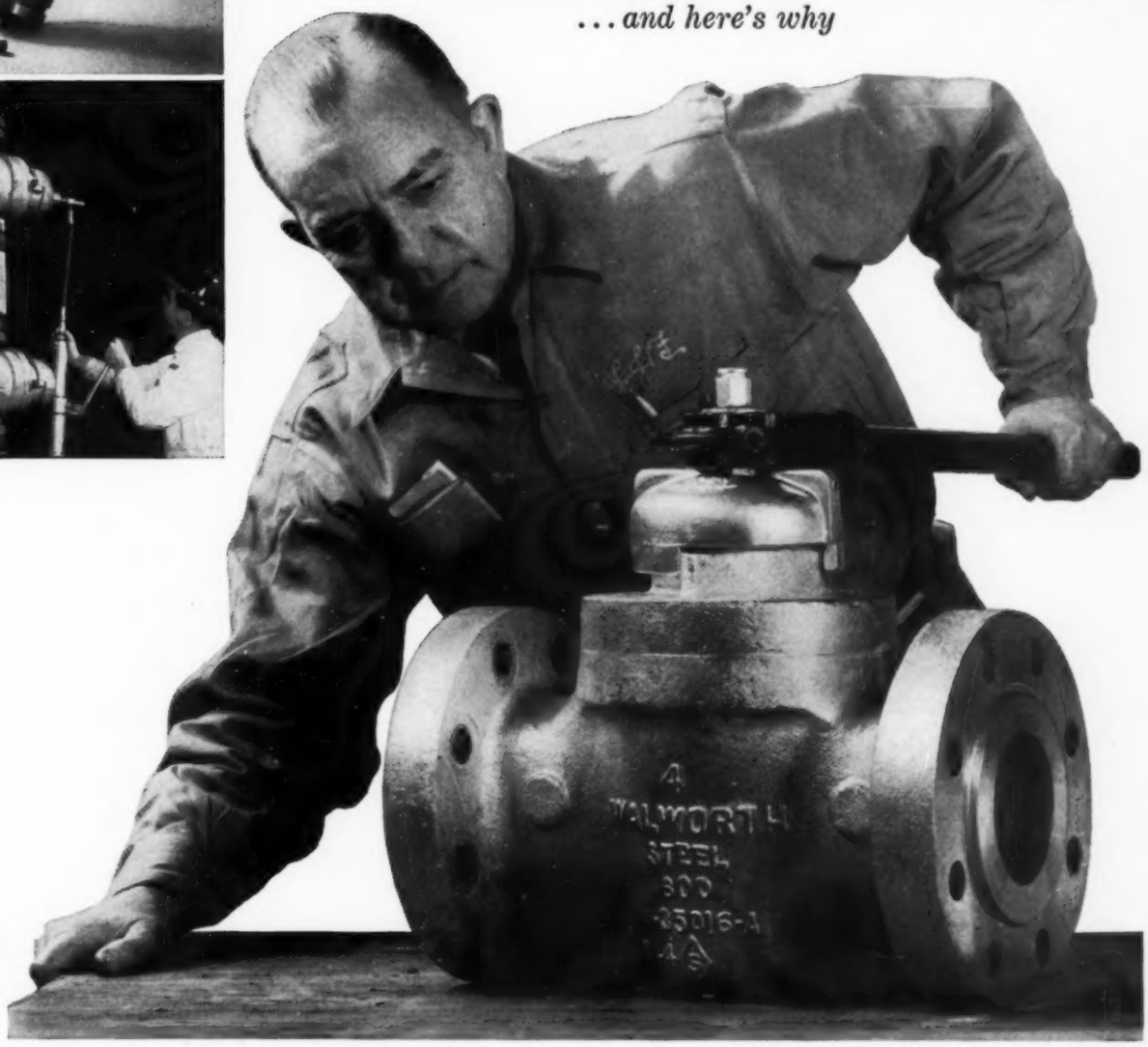
Contributors do not necessarily have to be alumni of the school to which they contribute. The employe's contribution must have a value of at least $10. Company matching contribution cannot exceed $500 per employe.



the **WALWORTH CUSTOMER**
wants a quick operating,
sure, tight valve. He chooses a

WALWORTH LUBRICATED PLUG VALVE

. . . and here's why



When the Walworth Customer has to decide on a valve that will close fast and easily, he wants to know HOW fast . . . HOW easily. Tight closure? Of course. But can the valve be serviced under pressure? Yes. Still, he tries one himself.

In the Walworth Lubricated Plug Valve he finds 100% tight closure because it is lubricant-sealed against leakage. He finds it opens or closes with a quarter turn. Then, and only then, he's ready to buy. If that's the way you like to buy valves, we want you, too, for a Walworth Customer. For details on all types and ratings of Walworth Lubricated Plug Valves, ask your Walworth Distributor.

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Radioactive Decontamination

"The expanded use of radioisotopes by both industrial and research organizations has necessitated a more widespread knowledge of radioactive decontamination procedures by state and local officials," says Leonard Tischler of Tracerlab, Inc. Speaking before 200 scientists and officials at a Florida nuclear conference, Tischler also emphasized the necessity of precautions which will prevent, wherever possible, the occurence of radioactive contamination.

The meeting was sponsored by the Florida Nuclear Development Commission and attended by representatives of institutions, universities and officials engaged in the Florida nuclear development program.

Texas Eastern Diversifying

Texas Eastern Transmission Corporation President Orville S. Carpenter, speaking before the New York Society of Security Analysts pointed out that Texas Eastern is diversifying its operations.

"If I were asked to state in one sentence what kind of a company Texas Eastern is today, I think I should reply that it is now a pipe line supplier of energy," Carpenter commented. A supplier of natural gas to the east and petroleum products to the midwest, Texas Eastern is now considering a coal pipe line from Virginia to New York.

Carpenter referred to the new technique of purchasing gas reserves in the field which Texas Eastern did in acquiring the Rayne field leaseholds in South Louisiana. This enabled the company "to effect some reduction in the initial cost over the entire life of the field." Rayne field reserves purchase added approximately one trillion cubic feet of gas to Texas Eastern's reserves. Presently Texas Eastern is taking about 100 MMcf of gas daily from the field.

To further develop its Little Big Inch system, Texas Eastern has purchased "Project Five Pipeline" from El Dorado, Ark., to Helena, at the Mississippi lines. The line was purchased from Gulf, Socony, Lion and Premier oil companies. A delivery extension to the Martin Oil Terminal in the Blue Island area of Chicago also has been added.

Corrosion Control Systems

A two-day course in practical corrosion control systems, sponsored by the Houston section of the NACE will be held at the Rice Hotel, Houston, January 28-29.

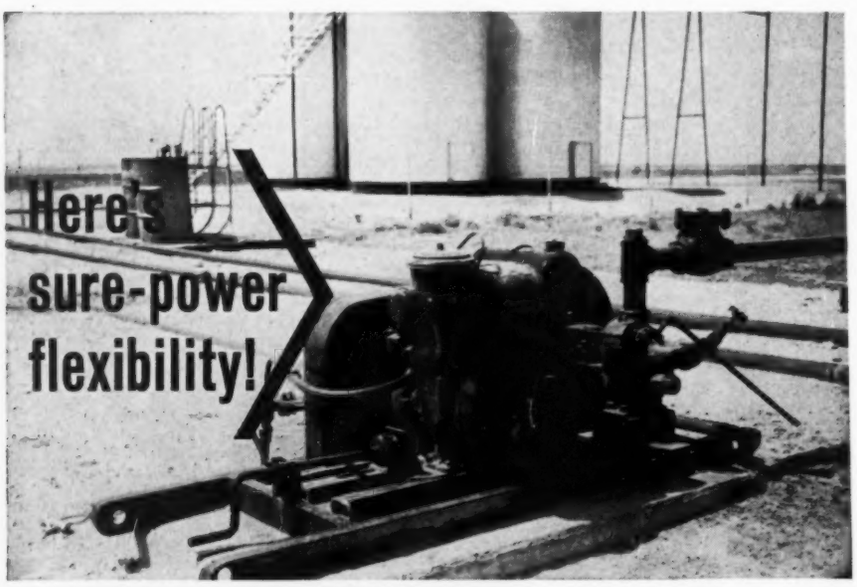
The opening day of the course will be devoted to fundamentals of corrosion and corrosion control. Individual full day sessions will be offered on the second day for pipe line industry, utilities, oil and gas production, industrial and chemical plants and commercial and residential construction.

Pipe Lines Consolidated

Mobil Oil Company will consolidate its eastern and mid-western pipe line systems into Magnolia Pipe Line Company, an affiliate with headquarters in Dallas.

The central pipe line division, headquartered in Wichita, Kan., and eastern division, Plainfield, N. J., will be joined in Magnolia Pipe Line Company.

When the consolidation is completed, Magnolia Pipe Line will have over 15,000 miles of crude and products lines. It will transport about 900,000 barrels per day of crude and products.



WISCONSIN-POWERED unit handles tank bottoms at 20 bbls/hr, 100 psi ...up to 70 bbls/hr at 50 psi

The unique oil-circulating unit shown provides the flexibility and all-weather power dependability so vital to trouble-free pumping at "oil patch" outposts. Heart of the equipment is the 4.4-hp AEH Wisconsin air-cooled engine — the rugged workhorse specifically designed for oil-field service.

For this application, the AEH has a built-in gear reduction and a specially-machined step-sheave belted to a 2-inch rotary pump. This arrangement enables the unit to handle tank bottoms at any desired capacity and pressure between the stated minimum and maximum. Another extra is the special sliding base which allows the operator to start the engine with practically no load — a big help when operating in extremely cold weather.

The AEH is precision-built for long-lived service under the most severe operating and weather conditions. It has tremendous load-lugging power to handle sudden shock loads without stalling — and to resist their after-effects. It is virtually maintenance-free because air-cooling eliminates radiators, water pumps, water, anti-freeze, and other troublesome parts and problems associated with water-cooled engines.

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What's Happening

among MEN in the INDUSTRY

School of Pipe Line Technology

The seventh session of the semi-annual School of Pipe Line Technology was held at Lee College, Baytown, Texas. Sponsored by the API, Committee on Personnel Training, Division of Transportation and the University of Texas Petroleum Extension Service, the school is a six-week course with special emphasis on liquid pipe lines. Thirteen of the 26 members attending this session were from foreign pipe line companies.

Burton T. Mast

H. D. Henderson

Burton T. Mast and **Howard D. Henderson** have been elected vice presidents of **Trunkline Gas Company.**

Henderson, manager of production and supply since 1956, has 33 years experience in the petroleum industry. He began his career with Sands Petroleum Company and has worked with White Eagle Oil and Refining Company, Skelly Oil Company and Sohio Petroleum Company. He has served as a director for the Texas Mid-Continent Oil and Gas Association.

Mast, chief engineer for Trunkline since 1954, served eight years with Tennessee Gas Transmission Company before joining Trunkline. He is president of the Houston Engineering and Scientific Society, and is chairman of a Southern Gas Association committee for the non-destructive inspection of steel pipe.

New officers and directors of the **American Gas Association** were announced at its annual convention in Chicago Oct. 5-7. **Lester T. Potter,** president of **Lone Star Gas Company,** was elected first vice president. Named to two-year terms on the board of directors were **Buell G. Duncan,** president, **Peidmont Natural Gas Co., Inc.,** and **Ralph T. McElvenny,** president, **Michigan Consolidated Gas Co.** Other newly elected directors include **Ed Parkes,** president, **United Gas Corporation; John W. Partridge,** president, **United Fuel Gas Co.; N. R. Sutherland,** president, **Pacific Gas and Electric Co.; S. D. Whitman,** president, **Kansas-Nebraska Natural Gas Company, Inc.,** and **John H. Wimberly,** president, **Houston Natural Gas Corp.**

Selected to head the Operating section were **J. T. Innis, Northern Natural Gas Company,** chairman; **H. L. Fruechtenicht, Consumers Power Co.,** second vice chairman; and **Samuel W. Horsfield, Long Island Lighting Co.,** first vice chairman.

Wister H. Ligon, president, **Nashville Gas Co.,** was elected president of the Association. **Edward H. Smoker, United Gas Improvement Co.** was named second vice president; and **Vicent T. Miles, Long Island Lighting Co.** was elected treasurer.

Tidewater Oil Company has announced the appointment of **H. F. Tomfohrde** to the post of transportation manager, home office.

H. F. Tomfohrde

Formerly with Tidewater's Eastern Division Transportation and Supply Department, Tomfohrde will headquarter in Los Angeles. He will develop and coordinate policies, plans and procedures covering all phases of Tidewater's transportation activities. Tomfohrde joined Tidewater in 1929. In 1956 he was named eastern division lubricants supply manager and in 1957 became division transportation manager.

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N. E. Tanner, director of **Trans-Canada Pipe Lines Limited,** was named president of the **Canadian Gas Association** at its annual meeting in Victoria, B.C.

R. C. McPherson, senior vice president, **Canadian Western Natural Gas Company,** was elected first vice president, and **O. L. Jones,** vice president and general manager, **Consumers Gas Co.** was named second vice president.

Gilbert F. Moore has been named president of the **Pan American Gas Company,** a **Pan American Petroleum Corporation** subsidiary. Headquarters for the gas company and Moore will be relocated from Houston to Tulsa.

Moore also has been named to the newly-created position of manager of gas sales.

J. A. Golasinski has been named manager of **Shell Oil Company's** Houston area Gas Department. He joined Shell in 1937, and has over 22 years experience in the company's Gas Department. Since 1954 he has served as superintendent of operations in Houston.

Tennessee Gas Transmission Company announces the appointment of **Hulette F. Aby** as associate general attorney. Aby formerly had been general counsel to **Middle States Petroleum Corporation.** He Joined Deep Rock Oil Corporation in 1937 and served as assistant general counsel until 1947.

The American Gas Association operating section presented awards of merit to 21 gas industry engineers at its annual meeting in Chicago, Oct. 5-7.

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N W E S

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FORMULA 291

Skin Saver

*Fieldjointer Patent # 2763047

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President **J. T. Wolfe** presented the awards to the following gas transmission personnel: **J. G. Barnhart, Natural Gas Pipeline Company of America; Rex V. Campbell, American Louisiana Pipe Line Company; N. P. Chesnutt, Southern Union Gas Co., H. B. McNichols, B. J. Clark,** and **L. L. Elder, The Columbia Gas System Service Corp.; Samuel H. Graf,** consultant; **W. B. Haas, Northern Natural Gas Company; L. R. Kirk, Ohio Fuel Gas Co.; Calvin Scott, Oklahoma Natural Gas Co.** and **C. L. Woody, United Gas Corporation.**

A. H. Gibson

W. H. Sands

A. H. Gibson, personnel manager for **Sinclair Pipe Line Company** has been promoted to executive assistant to the president of the company. **W. H. Sands** succeeds Gibson. He formerly was personnel representative. Gibson has been with the company since 1933 and Sands since 1951. Other Sinclair changes include the appointment of **J. H. Renard** as vice president, director and a member of the executive committee. He replaces **C. F. McCoy** who was transferred. Renard will coordinate staff functions dealing with the industrial relations, personnel, public relations, safety, organization and personnel development, printing and building maintenance.

J. H. Renard

Mid-Valley Utility Constructors, Inc., has changed its name to **Mid-Valley, Inc.** The Mid-Valley, Inc., offices are located at 4241 Gulf Freeway, Houston.

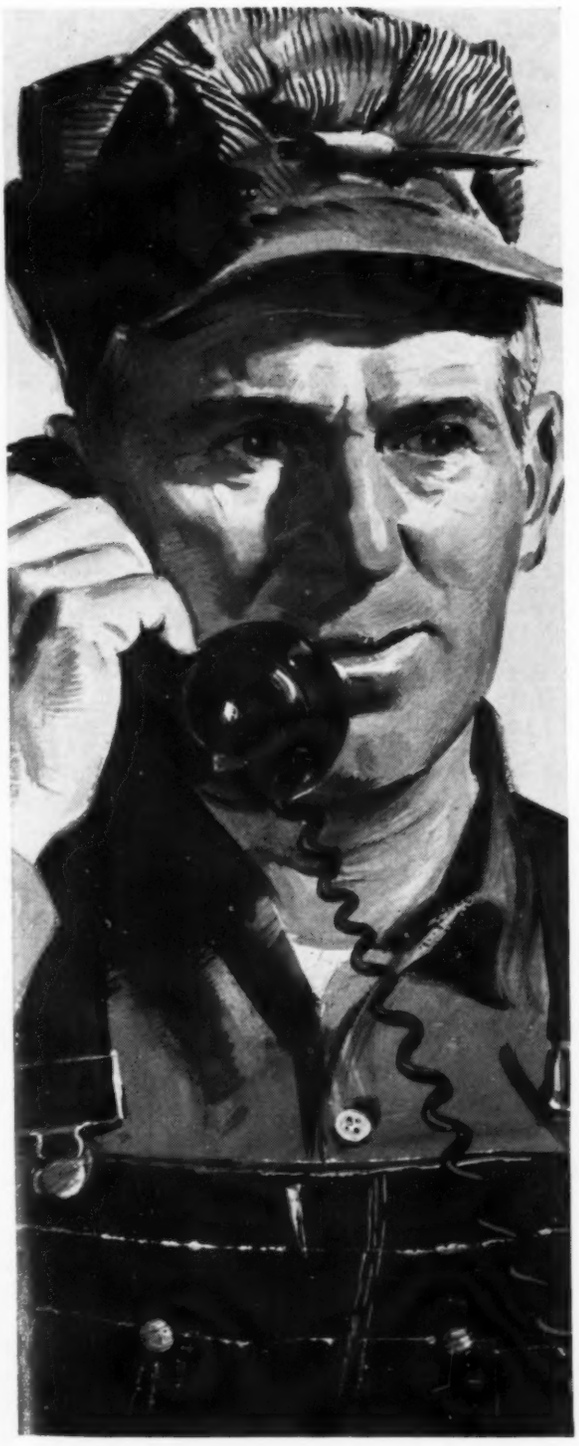
United Gas Corporation announces the promotion of three men to positions in general office. **J. D. Davis,** assistant to president since 1957, becomes a vice president of the firm. **V. S. Brennan** was named director of sales and rates and **W. D. Parkes** has been appointed director of personnel.

Davis has been with the company for 34 years. He was elected a director of the **United Gas Pipe Line Company** in 1954. Brennan has been with United Gas for 25 years and was appointed director of personnel in 1955. Parkes, formerly training supervisor in the Personnel Department, has been with the company for 28 years.

John W. Coolidge has been named assistant chief petroleum engineer of **Trunkline Gas Company.** Coolidge joined the company in 1955 as a petroleum engineer.

Why 4-wire switching?

BECAUSE MODERN PIPELINE COMMUNICATIONS DEMANDS IT!



Q: What is a 4-wire switching system?

A: An economical means of switching 4 wires of a carrier (or microwave) circuit to **eliminate hybrid coils at intermediate points** on thru (tandem) connections.

Q: What are the advantages of Stromberg-Carlson's 4-wire system?

A: Provides vastly improved transmission (Db gain at each point); reduces terminating net loss by **eliminating echo and singing** at intermediate switching points.

Q: Are there additional applications?

A: Yes . . . two major ones:

1. Tie-trunk concentration. Permits concentration of inward and outward traffic by single-digit access, over a minimum number of tie-lines serving several trunk groups. Eliminates use of tie-trunks for thru (tandem) connections. This saves on the number of direct circuits required between switching centers.
2. You can set up connections for teletypewriter transmission and connections between data transmitting and receiving points.

Q: Can the system be expanded?

A: The Stromberg-Carlson 4-wire system is modular in design, allowing for **easy, economical expansion.**

Q: Can a Stromberg-Carlson system be leased?

A: Systems are available **for lease or purchase.** For complete details write to Telecommunication Industrial Sales, 127 Carlson Road, Rochester 3, New York.

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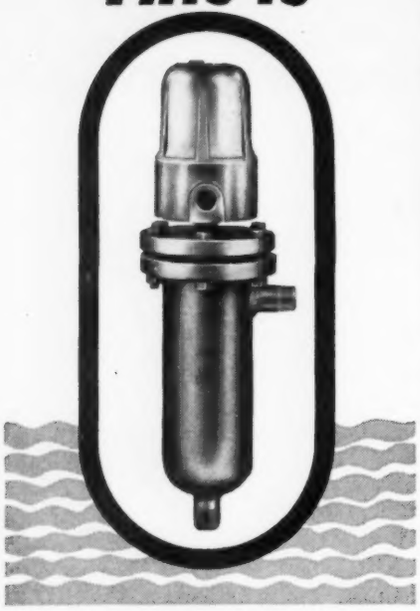

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Send full information on Level Master and name of nearest representative.

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Richard J. Plank **Fenton H. Finn**

Richard J. Plank has been named executive vice president of **New York State Natural Gas Corporation,** and President **Fenton H. Finn** has announced that he will retire February 1960. Plank will then succeed Finn as president.

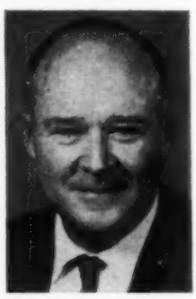
Plank has been vice president for operations of the **Peoples Natural Gas Company,** an affiliated company in the **Consolidated Natural Gas System.** Previously he had been chief engineer for Peoples and New York State. He joined New York State in 1936.

Finn has been affiliated with the company since 1932. He was named vice president in 1951, and president in 1953. He also is a director of Consolidated Natural Gas Company.

Walker L. Cisler, president of **Detroit Edison Company,** was elected president of the **American Society of Mechanical Engineers.** Four vice presidents and three directors were also selected. **Charles H. Coogan, Jr., University of Connecticut; Donald E. Marlowe, Catholic University of America; Henry N. Muller, Jr., Canadian Westinghouse Company, Ltd.;** and **William C. Heath, Solar Aircraft Company** were named vice presidents.

New directors include **Everett M. Barber, Texaco Inc.; William H. Larkin, Air Preheater Corporation;** and **Clarence C. Franck, Sr., Westinghouse Electric Corporation.**

Carlton O. Relephord and **H. Lee Norris, Jr.,** have formed a pipe line engineering firm of **Relephord & Norris, Consulting Engineers.** The firm will specialize in engineering and construction management services to the oil and gas pipe line industries.



C. O. Relephord **H. L. Norris, Jr.**

Relephord returned to Houston from Paris, France, where he was associated **with Bechtel Mediterranceenne, S.A.,** as chief engineer for the design and engineering of the 24-inch Zarzaitine-Mediterranean crude line in Africa. Norris was previously connected with Kinzbach Tool Company as chief engineer and served as chairman of the manufacturers committee of the ASME.

WRITE FOR CATALOG S-1

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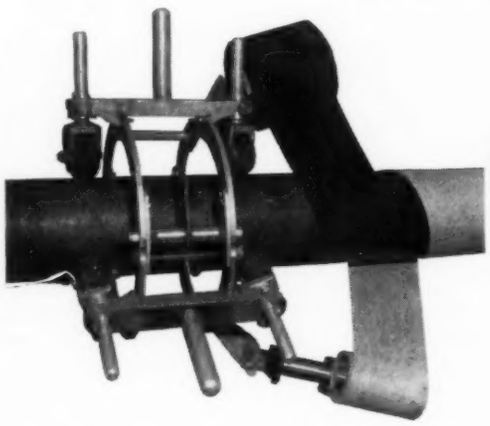
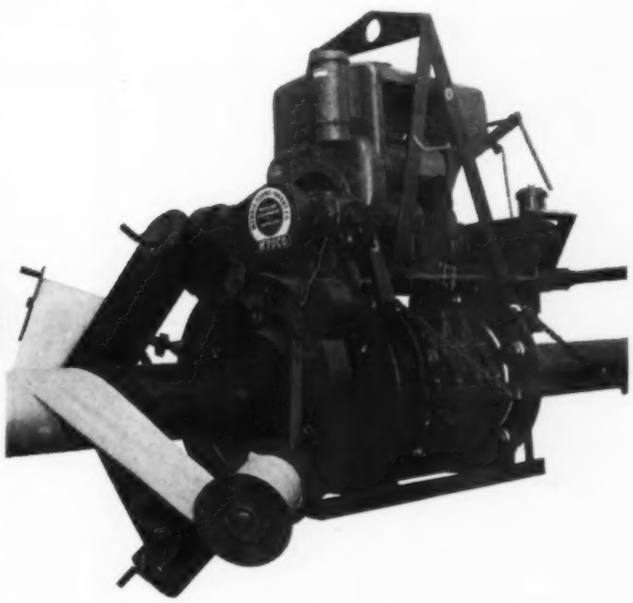
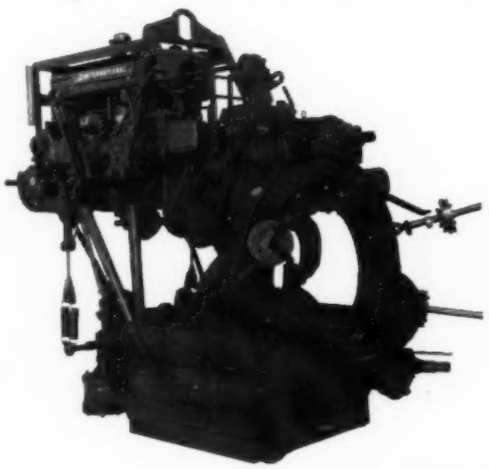


The MYOCO Tapemaster can use four arms to give any combination of tape and kraft or felt. Six various size machines available for ½" thru 36" pipe; small machines use tape from ½" width thru 9", large machines use 9" thru 18" tape.

MYOCO Model OW Power Driven Cleaning and Taping machine combines two operations for increased speed of operations with less equipment. Line travel machines are available to handle pipe sizes 3" to 6", 6" to 12", and 14" to 20". A Wisconsin Model Vg4D V-type 4-cylinder heavy-duty air cooled engine, combined with the design and engineering features of this machine, guarantees uninterrupted service.





The MYOCO Coating and Wrapping Machine is powered by an International Gasoline Engine, with electric starter, spray type shoes, and heavy-duty transmissions and clutches. This new machine features under-pressure-crawler wheels equipped with hydraulic cylinder to maintain positive contact, easily controlled by the operator.

When you use MYOCO pipeline equipment, you quickly find that servicemen are experienced and available twenty-four hours a day, with fast transportation available to serve you in any way; efficient equipment operation is assured by periodical checks; and if possible, parts and supplies are shipped the same day ordered.

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Robert W. Gerhard has been appointed director of economic research of **Societe Civile Amoco,** the foreign market study group in Paris, France, for **Standard Oil Company of Indiana.**

Gerhard is director of the distribution economics coordination division in the Supply and Transportation Department of Standard. Organizational changes in the department includes, appointment of **Donald S. Warning** as director of marketing research. **Howard A. Parker** has been appointed manager of coordination and supply planning in the Supply and Transportation Department.

Orville Roberts has been promoted to manager of the newly created Organizational and Personnel Development Department for **Sinclair Pipe Line Company.** Roberts formerly was administrative assistant.

Dr. Leon N. Moses has been appointed assistant director of research for the Transportation Center at Northwestern University.

Moses received his master's degree in economics from Harvard University in 1949 and his Ph.D. degree in economics from Harvard in 1952.

Paul F. Schmidt has been promoted from chief process engineer to chief technical supervisor for **El Paso Natural Gas Products Company. James C. Arnold,** formerly chief electrical engineer, is now chief general engineering supervisor.

Keith Claiborne replaces Schmidt as chief process engineer and **J. H. Riddle** is now chief, technical services. Riddle previously was assistant to the superintendent of refineries.

Morgan Martin

Melvin A. Judah

The Houston Pipe Liners Club elected **Morgan Martin, Gulf Refining Co.,** president for the 1959-60 year. Other officers chosen include **Melvin A. Judah,** PIPE LINE INDUSTRY editor, vice president; **Robert Pyle, Tennessee Gas Pipeline Company,** secretary; and **S. O. Crichfield, Shell Pipe Line Company,** treasurer. New directors are **Wilbur Moore, Humble Pipe Line Company; D. R. Croft, Transcontinental Gas Pipe Line Corporation,** and **Pat Kelly, Mavor-Kelly Company.**

Several appointments have been announced by **Natural Gas Pipeline Company of America** and **Texas Illinois Natural Gas Pipeline Company.**

F. J. Hopkins has been named coordinator of contracts for NGPL Amarillo production office in a newly created position. **T. R. Stalnaker** has been transferred to the TING compressor station near Malvern as superintendent replacing **A. E. Moody** who retired. **R. W. Horst,** superintendent of NGPL Pampa station, succeeds Stalnaker as superintendent of the TING Jackson, Mo. station.

R. W. Lindgren replaces Hopkins as administrative assistant to the president of both firms. **J. E. Stoffregen,** special engineer becomes Pampa superintendent. **Harvey R. Baker** replaces Lindgren as acting superintendent of the work order department, Chicago office headquarters.

H. R. Rohwedder has been named assistant director of operations and **J. G. Barnhart** was made assistant general superintendent of compressor stations for NGPL and TING. Rohwedder formerly was superintendent of TING stations and Barnhart had been superintendent of NGPL stations.

Maurice A. Riordan of **Rio Engineering Co.** has been elected chairman of the NACE committee T-2A (Galvanic Anodes).

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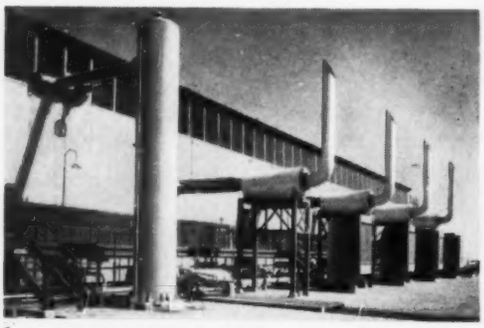
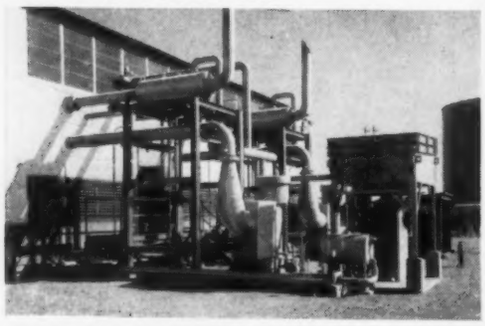
COMPRESSORS AND



GENERATORS ARE



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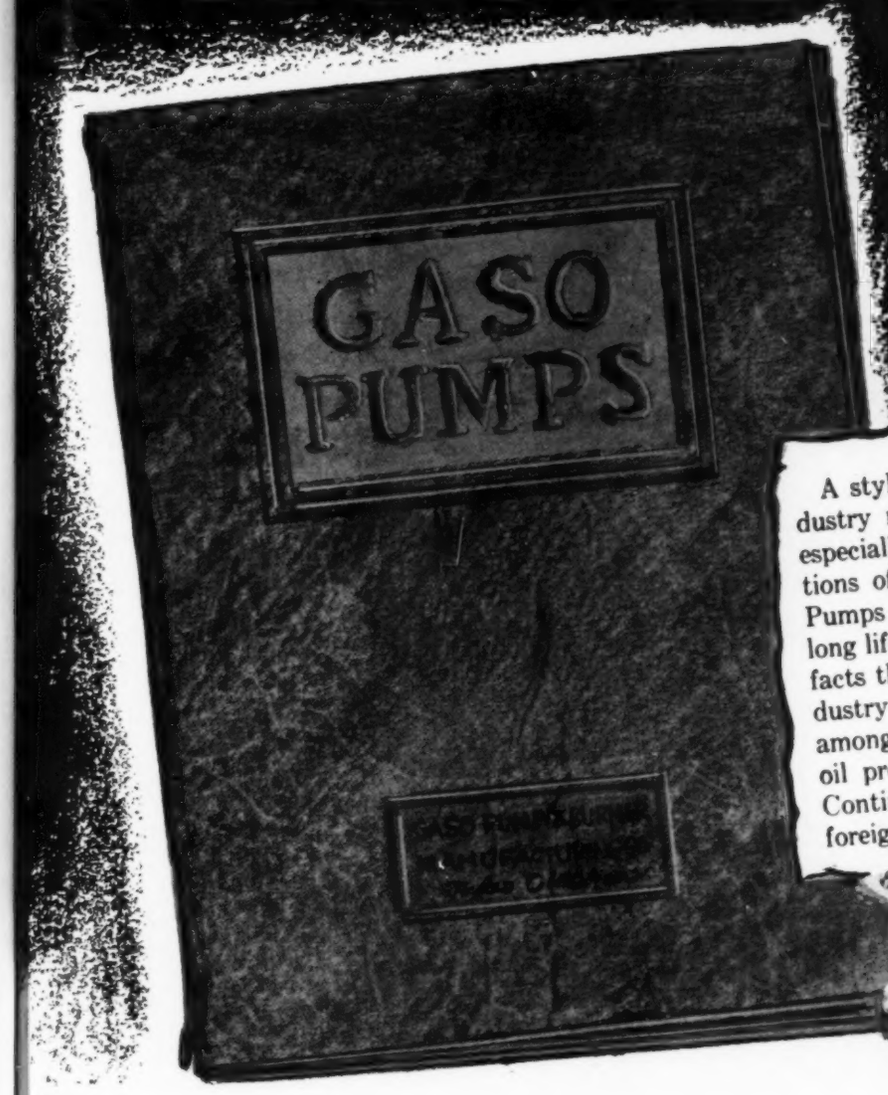

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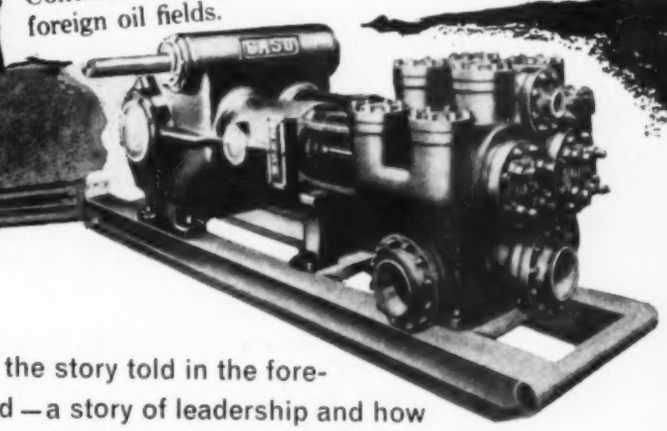

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WHO'S MEETING WHERE

November

Radioisotope Technique Short Course, University of Oklahoma, Nov. 2-6.

Rocky Mountain Oil & Gas Association, Fourteenth annual convention, Cosmopolitan Hotel, Denver, Nov. 4-6.

Institute of Radio Engineers, automatic control national conference, Sheraton Hotel, Dallas, November 4-6.

Institute of Radio Engineers, fourth instrumentation conference, Atlanta Biltmore Hotel, Atlanta, November 9-11.

API, 39th annual meeting, Conrad Hilton, Palmer House and Congress Hotels, Chicago, Nov. 9-11.

NACE, Fourth annual general Florida conference short course, Key Biscayne Hotel, Miami, Fla., November 16-20.

Natural Gas Pipe Line Institute, new Seward County Courthouse, Liberal, Kan., November 17-18.

West Central Texas Oil and Gas Association, annual meeting, Hotel Windsor, Abilene, Texas, November 19.

NGAA, Panhandle-Plains regional meeting, Herring Hotel, Amarillo, Texas, November 20.

ISA, Philadelphia section, symposium, Ben Franklin Hotel, Philadelphia, Nov. 23-24.

ASME, annual meeting, Chalfonte Haddon Hall, Atlantic City, Nov. 29-Dec. 4.

December

Eastern Joint Computer Conference, sponsored by AIEE, ACM and IRE, Hotel Statler, Boston, Dec. 1-3.

NACE, University of Illinois short course, Urbana Campus, December 7-11.

Society of Automotive Engineers, Sheraton-Cadillac and Statler Hotels, Detroit, Dec. 11-15.

1960

January

NGAA, Gulf Coast regional meeting, Robert Driscoll Hotel, Corpus Christi, Jan. 22.

NACE, Corrosion control short course, University of Houston, Houston, Jan. 22-23.

Pipe Line Contractors Association, 12th annual meeting, Ambassador Hotel, Los Angeles, Jan. 31-Feb. 3.

February

Instrument Society of America, Instrument-Automation Conference and Exhibit, Houston Coliseum, Houston, Feb. 1-5.

Canadian Contractors Association, annual meeting, Empress Hotel, Victoria, B.C., Feb. 25-27.

NGAA, Permian Basin Regional meeting, Lincoln Hotel, Odessa, Texas, Feb. 26.

March

ASME, Gas Turbine Power Division, fifth annual gas turbine conference and exposition, Rice Hotel, Houston, March 6-9.

NACE, 16th annual conference, Dallas Memorial Auditorium, Dallas, March 14-18.

NGAA, Oklahoma Regional meeting, Biltmore Hotel, Oklahoma City, March 18.

Mid-West Gas Association, annual meeting, Hotel St. Paul, St. Paul, Minn., March 21-23.

New England Gas Association, annual meeting, Statler Hotel, Boston, March 24-25.

April

PIEA-PESA, Thirty-second annual petroleum industry conference and exhibition. Hotel Muehlebach and Municipal Auditorium, Kansas City, Mo., April 12-14.

Southwestern Gas Measurement Short Course, Drill Hall, North Campus, University of Oklahoma, April 19-21.

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Indiana Gas Association, French Lick-Sheraton Hotel, French Lick, Ind., April 20-22.

Southern Gas Association, annual meeting, Galveston, Texas, April 25-27.

American Welding Society, 41st annual meeting and exposition, Los Angeles, April 25-29.

API, Division of Transportation, pipe line conference, Mayo Hotel, Tulsa, April 28-29.

May

AGA Operating Section, Joint distribution and transmission conference, Roosevelt and Jung Hotels, New Orleans, May 9-13.

BOOKS

THE DRINKING PROBLEM . . . And Its Control, The Gulf Publishing Company, P. O. Box 2608, Houston 1, Texas, by Dr. C. A. D'Alonzo, M. D., F.A.C.P., Price $2.95.

The problem of alcoholism is probably one of industry's biggest headaches. One of 50 industry employes is an alcoholic. The alcoholic has twice as many accidents as the non-alcoholic. Alcoholics lose 36 million working days a year . . . and cost our national economy more than $1 billion dollars annually. Recognizing the need for a concise and authorative book on alcoholism, Gulf Publishing Company has published this book. Dr. D'Alonzo, the author, is assistant medical director for E. I. Du Pont de Nemours and Company. The book covers important questions such as What is alcoholism? What are the fears of the alcoholic? Is there a typical description of an alcoholic? What is Industry's role? What is the treatment? What is the cure? The book deals not only with alcoholism generally, but also discusses its effects, care and treatment when encountered on the job.

THE EARTH BENEATH THE SEA, by Francis P. Shepard, The Johns Hopkins Press, Baltimore 18, Md. Price $5.

This book is an account of the latest discoveries in the geology of the sea, along with interpretation of the origin of submarine topography and a discussion of the processes which are operating in the sea and along the coasts.

The book is written in a light style so that it can be read without a background of technical knowledge.

OIL ON STREAM, by John L. Loos, Louisiana State University Press, Baton Rouge 3, La. Price $6.

Oil On Stream is a history of Interstate Oil Pipe Line Company from 1909 until 1959. The 412-page volume describes all aspects of the company's operations including construction of the original trunk line running from near Tulsa to Baton Rouge, La. The author also covers the growth of the system to more than 4,500 miles of trunk and gathering lines; changes in techniques and equipment over the half-century; and the company's dealings with landowners and its relations with Standard Oil Company of New Jersey.

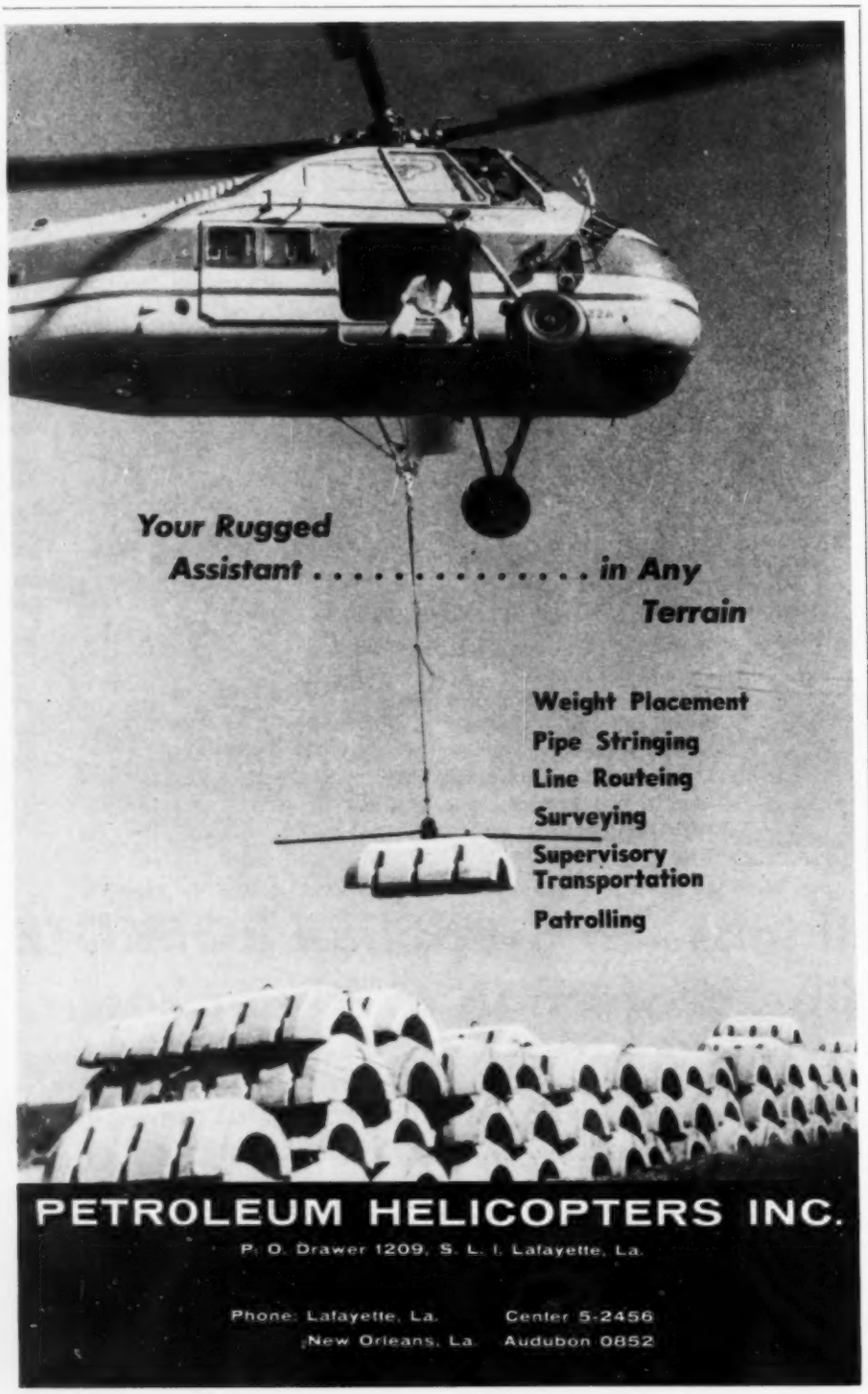
There are chapters devoted to state and federal regulations and employee-management relations.

ESTIMATOR'S PIPING MAN HOUR MANUAL, by John S. Page and Jim G. Nation, Gulf Publishing Company, P. O. Box 2608, Houston 1. Price $7.50.

The authors, estimators by profession, have found after much comparison on many projects that production percentages can be classified into five categories, namely: very low, low, average, very good and excellent. And, that production elements can be grouped into six different listings or categories which are: general economy, project supervision, labor relations, job conditions, equipment and weather.

Using the above experience, the authors have devised an accurate and convenient method of estimating direct labor for complete fabrication and installation of process piping for any given system. Thus, by means of this manual, the reader has a method of obtaining production efficiency percentage by applying all known local conditions and variables . . . plus a method of obtaining a complete direct labor rate for the craft or crafts involved in the various operations.

Subject areas covered include: shop fabrication of pipe and fittings, field fabrication and erection, alloy and non-ferrous fabrication, underground piping, hangers and supports, painting, patent scaffolding and insulation. To enable the reader to get more from the manual, the authors have provided a comprehensive sample estimate. Also, there is a section devoted to technical information which will be of benefit to the reader in preparing an estimate.



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What's Happening among SERVICE and SUPPLY MEN

Pipe Coating Yard Facilities Expanded

Southern Pipe Coating Co. has undergone its third expansion and modernization program to meet production demands at its Atlanta, Ga. plant. Aerial view of 34-acre yard shows how bare pipe is brought to plant by rail, stored and fed through coating and wrapping process. Improved methods have upped production to more than a million feet per month.

Allis-Chalmers Manufacturing Elects Senior Vice Presidents

Boyd E. Oberlink and J. L. Singleton have been elected senior vice presidents for Allis-Chalmers Manufacturing Company. Roy M. Casper and L. W. Davis were elected vice presidents.

Oberlink joined the company in 1934, and became vice president, Construction Machinery Division in 1955. He was named Group vice president in 1956, and was elected to the board in 1957. Singleton has been with Allis-Chalmers since 1926. He was appointed Group vice president and elected to the board in 1951. Casper joined the firm in 1936, and Davis has been with the company since 1939.

Walworth Company Appoints Snowden Sales Representative

Walworth Company has appointed Robert F. Snowden as sales representative in the company's Gulf Division. Snowden previously was employed by the Stanolind Oil & Gas Company and was district manager for the Happy Company.

Dale W. Turnbull Promoted By Caterpillar Tractor Co.

Dale W. Turnbull has been promoted to supervisor of wheel tractors and motor graders, product section of products division for Caterpillar Tractor Co. Turnbull has been district representative in Oklahoma and Kansas since 1955.

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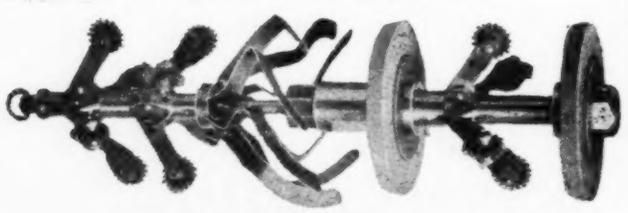
Heavy Duty Model with Neoprene cup or disc drivers



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M. J. Crose Appoints J. W. Brand Vice President

J. W. Brand has been appointed vice president of M. J. Crose Mfg. Co., Inc., with headquarters in Tulsa. Brand, vice president of Crose-Curren, Ltd., will continue to direct operations of the Crose Canadian subsidiary.

Brand joined the company in 1953 as a sales engineer and was appointed vice president of Crose-Curren, Ltd., in 1957. Prior to joining Crose, he had been a field representative for Williams Brothers.

J. W. Brand

Minneapolis-Honeywell Names Kelly Manufacturing Manager

Frank P. Kelly has been appointed manager of manufacturing operations for the Brown Instruments Division of Minneapolis-Honeywell Regulator Company.

He succeeds Frank M. Rea who has been assigned the Honeywell's Industrial Products Group as a consultant in industrial engineering, tooling and subcontracting. Kelly joined Brown Instruments Division in 1943.

Houston Instrument Corporation Merges With Three Subsidiaries

Houston Instrument Corporation has merged with its three subsidiaries, Crump Instrument Corporation, Houston Magnetic Products, Inc., and Instrument Mirror Manufacturing Company.

E. E. Crump, president of Crump Instrument Corporation, becomes vice president of Houston Instrument Corp. He will be general manager of Crump Instrument Division and Magnetic Products Division. E. V. Hardway remains president of the Houston Instrument Corporation.

T. D. Williamson Appoints Crandall General Sales Manager

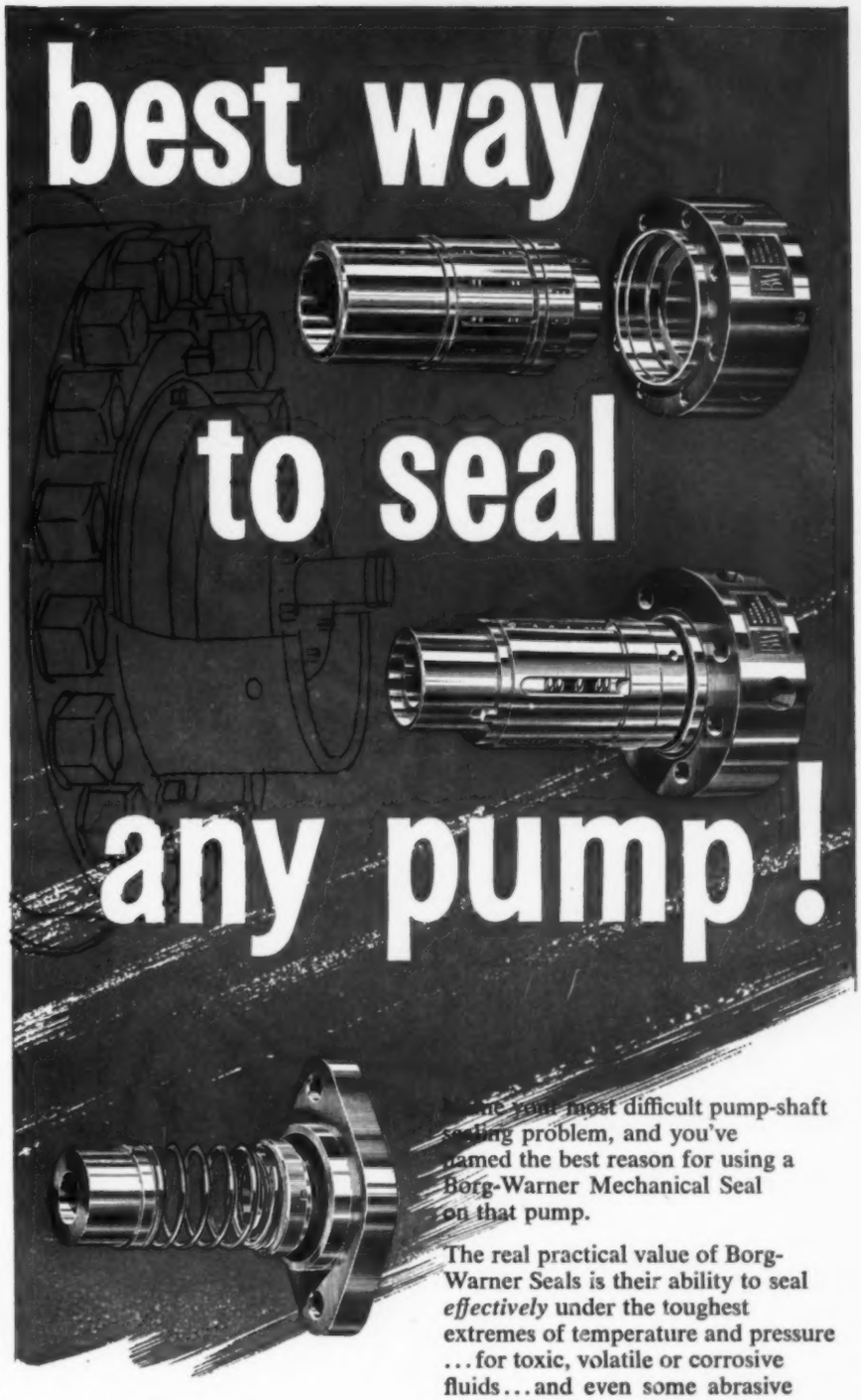
Fred B. Crandall has been appointed general sales manager for T. D. Williamson, Inc. Joining the firm in 1952 as research and development engineer, Crandall was appointed factory sales engineer in 1956 and later became acting general sales manager.

Fred B. Crandall

Before joining the company he was pipe line engineer with Phillips Petroleum Co. in its Products Pipe Line department.

W-K-M Receives Award of Merit From National Safety Council

The National Safety Council announced that W-K-M, Division of ACF Industries, Inc., has been presented the Council's award of merit for its excellent safety record. The company qualified for the award through its disabling injury-free period of 1,551,590 man-hours from Oct. 1, 1958, to July 12, 1959.



Name your most difficult pump-shaft sealing problem, and you've named the best reason for using a Borg-Warner Mechanical Seal on that pump.

The real practical value of Borg-Warner Seals is their ability to seal *effectively* under the toughest extremes of temperature and pressure ... for toxic, volatile or corrosive fluids ... and even some abrasive liquids. *Result*—less down time, elimination of expensive stuffingbox maintenance, and savings of the pumped fluid.

Borg-Warner Mechanical Seals

NOW AVAILABLE—a new file folder of Borg-Warner Mechanical Seal designs shows some of the many types and applications possible for pumps, mixers, autoclaves and for special rotating shaft problems. Send for your copy today—there's no obligation!

A PRODUCT OF B-W BORG-WARNER

Borg-Warner® Mechanical Seals

P. O. Box 2017, Terminal Annex, Los Angeles 54, California

For more data on advertised products, use Readers' Service Cards, last page.

Drilling with KA-MO . . .

6-in. bore under street —

Drilling 6-in. diameter hole, 40 ft. long under city street for gas line . . . this unit is powered by a 6 h.p. air motor using a standard double-track mounting. Ka-Mo drills are rugged, versatile . . . handle all materials from sand, clay, gumbo to frozen ground, shale, limerock . . . and other mineral formations.

24-in bore inside casing

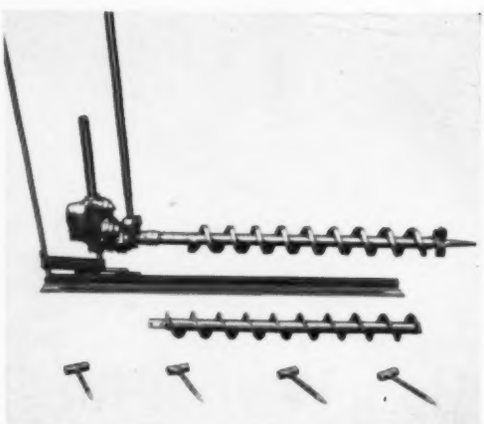
Powered by an 18 h.p. air motor . . . Ka-Mo horizontal drill quickly bored 24-in. diameter hole inside casing, 106 ft. long through compacted clay and ballast under a railroad bed for new gas distribution line. *Actual drilling time . . . only 4 hours!* Casing and drill move forward at same time, protecting against [illegible]tly cave-ins.

Whether your work involves angular, vertical or horizontal drilling, it will pay you to check the big Ka-Mo line. Drill sizes: 2 to 48-in. diameter, and larger . . . sectionalized lengths . . . air, hydraulic, electric, gasoline or diesel powered.

Light, portable —

Here's a "close-up" of a 6-in. dia. horizontal drill with 6 h.p. vane type air motor and single-track mounting. It's light, portable, easy-operating. Speeds installation of distribution and service lines under walks, streets, railroad beds, etc. Other sizes in this series: 3 to 14-in. dia., in sectionalized lengths, with single or double-track mounting.

Special engineering service always available on difficult drilling or boring problems. Call any time!



Mail to: KWIK-MIX CO., Ka-Mo Tools Dept., 1845 South 55th Ave., Cicero 50, Illinois

NAME .....
TITLE .....
COMPANY .....
STREET .....
CITY, STATE .....

Send free data on:
☐ horizontal ☐ vertical
☐ angular drilling equipment
☐ pipe anchor install. equip.
Dia. of hole ..... inches
Length of bore ..... feet
Type soil .....

KAMBOS PI

KA MO — KWIK-MIX COMPANY — Ka-Mo Tools Dept.
A DIVISION OF KOEHRING COMPANY

United States Steel Corp. Names Five Vice Presidents

The United States Steel Corporation announces the appointment of five vice presidents. Marcus M. Fisher and C. Burton Vernooy has been named administrative vice presidents—accounting. Wilbert A. Walker was appointed administrative vice president and comptroller; William L. Hearne was appointed vice president—taxes, and Leverne J. King was named vice president and assistant comptroller.

Walker joined the corporation in 1941, and became vice president and comptroller in 1955. Fisher has been with United States Steel since 1938, and was named assistant vice president in 1958. Vernooy began his career with the steel firm in 1919, and became vice president—accounting in 1958. Hearne joined the corporation in 1940, and has served as director of tax division since 1941. King, who has been associated with the corporation since 1930, became a director, cost and statistics, in 1957.

Oakite Products, Inc., Names New Field Representative

Robert L. Crowell has been appointed to the field service staff of Oakite Products, Inc., manufacturers of industrial cleaning compounds and equipment.

Mitchell to Head Case Company's Industrial Products Division

Donald H. Mitchell has joined the J. I. Case Co. as manager of the newly-formed Industrial Products Division. He will be responsible for product training, sales training, market analysis and dealer training.

Donald H. Mitchell

S. W. Brock, formerly sales representative of the Case Clausen Works, will be assistant manager of the new division and directly responsible for product training, including schools for demonstrators, district representatives and dealer personnel. G. W. Watts will be in charge of technical information.

Cooper-Bessemer Corp. Plans To Purchase Rotor Tool Company

Cooper-Bessemer Corporation proposes to purchase the Rotor Tool Company. The Rotor Tool Company name will be retained and the company operated as a subsidiary of Cooper-Bessemer.

L. D. Frazee Named Sales Manager Of Greenhead Sling & Supply Co.

L. D. Frazee has been appointed sales manager for Greenhead Sling & Supply Company. Frazee had been vice president of Kane Boiler Works Inc. He has spent the past 12 years in sales and public relations serving the oil, gas and chemical industries.

Peddlers, Inc. Changes Name to Texas Pump & Compressor Company

Peddlers, Inc., Houston distributors of Gaso Pump & Burner Mfg. Company, has changed the corporate name to Texas Pump & Compressor Company.

Cooper-Bessemer Corporation Promotes Laurence B. Hume

Laurence B. Hume has been promoted to the position of assistant manager, power engine sales. He will be responsible for the application and sales of gas, diesel, and gas-diesel engines for use in all stationary power, marine and other mobile services.

L. B. Hume

Other Cooper-Bessemer appointments include the promotion of Tom M. Lamberth as assistant to Southwest District manager, and the appointment of Clifton W. Woltz as branch manager of Shreveport, La., office.

Hume has been with the company since 1940, and has been in the Washington, D.C., sales office.

H. M. Jones Sales Manager For E. W. Robinson Supply Co.

H. M. Jones has been named sales manager for E. W. Robinson Supply Company. Jones formerly has been a Houston representative for Perrault Equipment Company. Prior to that he had served with several pipe line contractors.

Jones & Laughlin Supply Division Completes Hobbs Pump Repair Shop

Jones & Laughlin Supply Division has announced completion of a new pump repair shop at Hobbs, N.M. The shop is adjacent to the company's supply store in Hobbs. The sectional steel building measures 30 by 60 by 12 feet.

Richard A. Gentry Joins Gott Manufacturing Company

Richard A. Gentry has joined Gott Manufacturing Company at Winfield, Kan. Gentry had been with Continental-Emsco Co. since 1936, and had been Gulf Coast Division manager since 1954. Gentry purchased an interest in the company which manufactures water cans and water coolers.

Texas Pipe Binding Company Appoints Executive Vice President

Texas Pipe Binding Company announces two personnel promotions. George E. Duckworth, vice president—sales, has been named executive vice president. H. H. Leiber has been elevated to the position of vice president—sales. Leiber joins the company with 14 years experience in the prefabricated piping industry.

Childers Manufacturing Company Names Ahrens General Sales Manager

Don Ahrens has been appointed general sales manager of Childers Manufacturing Company. Ahrens comes to Childers from Paasche Air Brush Co. He will be responsible for aluminum jacketing, distribution of prefabricated steel buildings, walkway covers and industrial-commercial carports.

The Ralph M. Parsons Company Elects Peaslee Vice President

Robert V. Peaslee has been elected vice president of The Ralph M. Parsons Company. Formerly vice president of C F Braun & Co., Peaslee will be headquartered at Parson's New York office.

Check ✓ PARSONS® Trenchliners for pipeliners

✓ **Dig 20 TO 32 IN. WIDE with wide-wheel 170...**

Developed to meet your needs for wide work range in a *medium-size* machine, Parsons 170 wheel-type Trenchliner® is large enough for mainline trenching — yet small enough to be used as an auxiliary unit for opening laterals and gathering lines. It produces from 12 inches to 25 lineal feet of trench per minute — 20 to 32 in. wide, at depths to 5¾ feet.

Hydraulic power raises and lowers the wheel on vertical mast with fractional-inch accuracy — and tilts the mast for traveling or trailer-loading. But that's not all — a hydraulic control system on the conveyor gives belt speeds up to 600 feet per minute — *completely independent of digging wheel speeds.* Belt easily handles maximum yardages from the extra-wide wheel — puts spoil bank well back beyond edge of trench. To handle a wide range of soil conditions, Parsons 170 has cast-steel buckets with self-sharpening, reversible "Tap-In" teeth — or quick-change gumbo buckets. Want more facts? Contact Parsons distributor, or send coupon.

✓ **6 to 18 in. wide with little 77...**

Here's another Parsons Trenchliner that will interest you — the small ladder-type 77. It's only 3 ft.-10 in. wide — and just 5 ft.-8 in. "low" (with boom in digging position). It produces up to 21 lineal ft. of trench per minute — 6 to 18 in. wide. Depths to 5 ft. A complete selection of larger Parsons ladder and wheel-type machines also available.

Mail to: PARSONS Company, Newton, Iowa *A division of Koehring Company*

Send us literature on: ☐ 170 wheel-type ☐ 77 ladder-type Trenchliner

NAME ..... TITLE .....

COMPANY .....

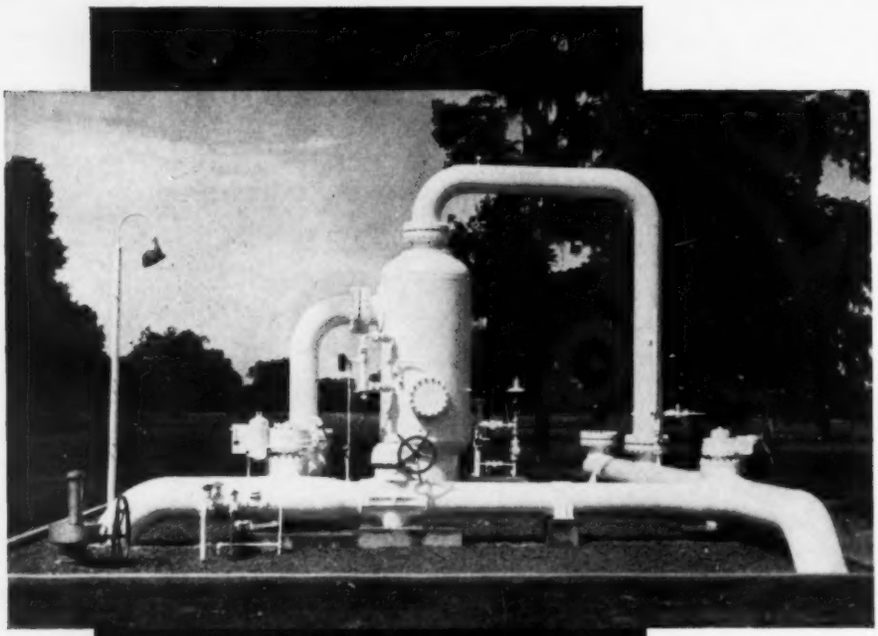
STREET .....

CITY ..... STATE .....

P821 PI

Trench widths from 6 INCHES to 6 FEET... depths to 19 FEET

For more data on advertised products, use Readers' Service Cards, last page.



NEW TEST RESULTS CONFIRM
AEROTEC CENTRIFUGAL
GAS SCRUBBER PERFORMANCE

For years Aerotec's advertising to the American Gas Industry has stressed the advantages of the dry centrifugal gas scrubber. These proven advantages are based not only on laboratory tests, but are substantiated by hundreds of actual installations on the major gas transmission lines and in distribution systems in many countries throughout the entire world.

No single equipment design will fulfill every requirement of a specification. Evaluation of a unit must be based on over-all performance. To determine the advantages of various scrubbing methods, tests sponsored by the American Gas Association were made on the three basic scrubber designs (filter, centrifugal and oil-bath). Results of these tests were reported in the American Gas Association Project NFX-12 Report, and verified these advantages of the Aerotec centrifugal scrubber.

1. Constant pressure drop across the scrubber regardless of dust loading or length of operating cycle.
2. No oil carryover. The Aerotec dry centrifugal scrubber actually agglomerates and collects liquids entrained in the gas stream.
3. 98 to 100% collection of particles exceeding 5 microns, and essentially 100% collection of particles 8 microns and larger.
4. Efficient operation over varying flow rates. A single unit can handle both present and future conditions.

It will pay you to look into these outstanding advantages of the Aerotec Gas Scrubber. Contact our engineers for further information.

AEROTEC INDUSTRIES, INC.
INDUSTRIAL DIVISION, DEPT. I, GREENWICH, CONNECTICUT
CANADIAN AFFILIATE: T. C. CHOWN LIMITED, MONTREAL, TORONTO
FAN-STACKS • BLOWERS • CURTAIN DAMPERS • AIR PREHEATERS • MECHANICAL AND ELECTRICAL DUST COLLECTORS FOR INDUSTRIAL PROCESSES AND FLY ASH • GAS SCRUBBERS FOR CHEMICAL PROCESSES AND NATURAL GAS TRANSMISSION LINES

M. J. Crose Mfg. Co. Acquires Perrault Equipment Company, Inc.

M. J. Crose Mfg. Co., Inc., has purchased the Perrault Equipment Company, Inc. Both companies have offices and facilities in Tulsa.

Crose will acquire Perrault's products and manufacturing facilities consolidating the companies' line of pipe line construction equipment.

Ellis D. Verink, Jr., Promoted By Aluminum Company of America

Ellis D. Verink, Jr., has been named manager of petroleum and chemical industry aluminum sales for Aluminum Company of America. He will coordinate a program to advance new and more effective aluminum applications in the chemical and petroleum industries.

Ellis D. Verink, Jr.

Verink joined Alcoa in 1946 as an engineer in the sales development division, and became manager of the chemical section 2 years later.

Phillip L. Arnold Appointed Service Engineer for Youngstown

Youngstown Sheet and Tube Company has named Phillip L. Arnold service engineer at the company's Detroit sales office. Arnold joined the company in 1957 in the metallurgical department.

Nurko Named Works Manager For De Laval Steam Turbine Company

De Laval Steam Turbine Company announces appointment of Paul S. Nurko as works manager. He joined De Laval in 1939 in the testing department and later was transferred to the Research and Development Department. In 1950 he was made assistant superintendent of tests and became superintendent of combined Erection and Test Departments operation in 1951.

Clark Bros. Co. Appoints Z. B. Deer, Jr., Sales Engineer

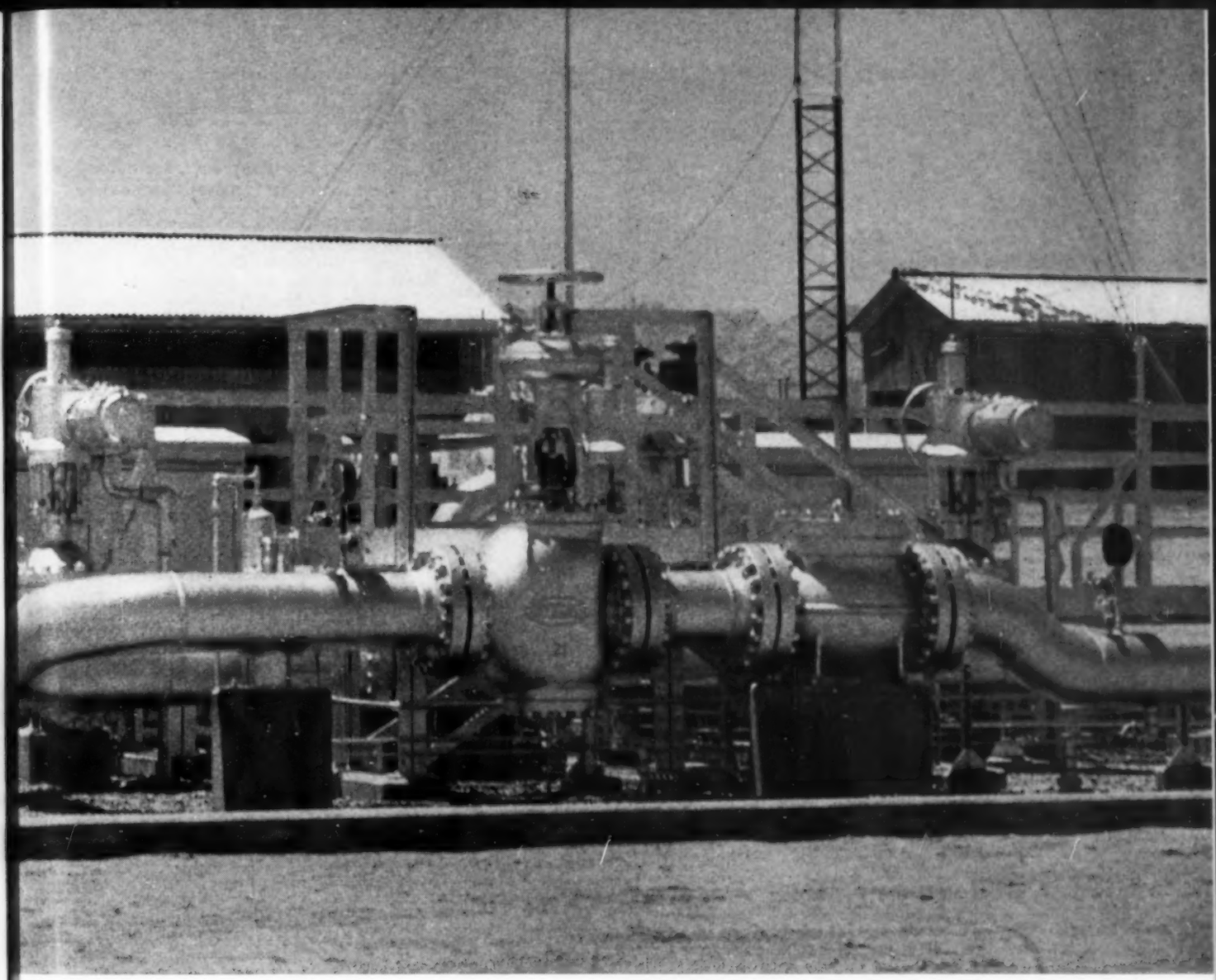
Z. B. Deer, Jr., has been named sales engineer for Clark Bros. Co. in the Texas-Oklahoma Panhandle area. Deer will be responsible for the sale of Clark engines, compressors and gas turbines in northern half of New Mexico, Oklahoma and Texas Panhandles and Liberal, Kan. area.

J. M. Potts Elected President Of Bonney Forge and Tool Works

Joseph M. Potts has been selected president of Bonney Forge and Tool Works. Potts served as vice president of Bonney and general manager of its Allentown, Pa., operation.

General Electric Appoints Dale L. Bunday Planning Manager

General Electric Communication Products Department has named Dale L. Bunday national product planning manager for two-way radio equipment. Bunday replaces Robert L. Casselberry who was named acting manager of Technical Products Operation. Bunday joined the company's communications marketing organization in 1952. He was named district sales manager for two-way radio in 1954.



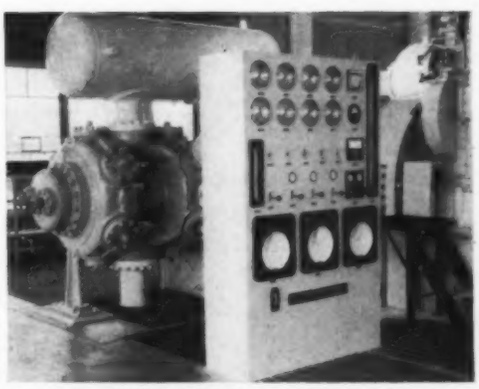
Typical installation of Control Valve for a Crude Oil Pumping Station.

Masoneilan Controls Demonstrate Dependability in Modern Pipeline Operation

Masoneilan Controls — instruments, control valves and auxiliary equipment — are demonstrating the dependable, low-maintenance service required for profitable pipeline operation. Remote station control, and other modern concepts designed to obtain operating simplicity and economy, demand this top dependability.

Versatility in application of standard Masoneilan products affords further opportunities for cost-saving. Extensive pipeline control experience enables Mason-Neilan engineers to exploit this versatility to your advantage.

For product data and application assistance, contact a Mason-Neilan representative, or write:



Masoneilan 60000 Series Instruments are used to control pressure at Compressor Stations for gas pipe lines.

MASON-NEILAN

Division of Worthington Corporation

61 NAHATAN STREET, NORWOOD, MASSACHUSETTS, U. S. A.

Sales Offices or Distributors in Principal Cities in United States and Abroad

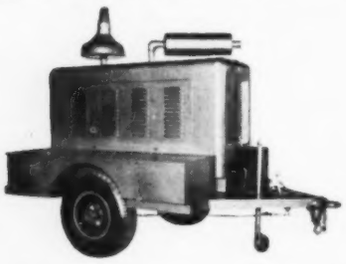
In Canada: Worthington (Canada), Ltd., Mason-Neilan Division

MN 9-54

There's VERSATILITY in your PIPE LINE SERVICE and Portability with...

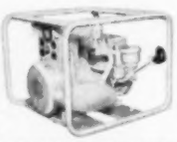
U.S.

Portable U.S. Versa-Trailer standby emergency power units in sizes from 10 kw to 35 kw capacity provide single phase power for lights and 3-phase power for other requirements.



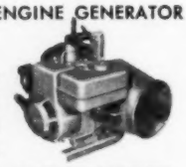
Versatile mobile power units provide for foolproof selection of desired current with selector plugs and cables.

Pipe Lines use convenient lightweight generating sets for lights, portable tools. Rugged construction.



ENGINE GENERATOR

Portable blowers are especially suited for ejecting smoke, fumes, stale, contaminated air, and for purging tank cars, field storage tanks, etc. Motor driven or engine blowers are available.



ENGINE BLOWER

MOTOR DRIVEN BLOWER

for complete information write . . .

UNITED STATES MOTORS CORPORATION
LIGHT U.S. POWER
OSHKOSH · WISCONSIN

UNITED STATES MOTORS CORPORATION

112 W. 5th Ave. / Oshkosh, Wis.

Ray V. Long

H. Dickinson

Vapor Recovery Systems Company Appoints Three Vice Presidents

Vapor Recovery Systems Company announces the appointment of three vice presidents. Ray V. Long has been named executive vice president, advancing from his prior position as vice president and sales manager. Arnold A. Wilcox becomes vice president—manufacturing, and H. Dickinson has been named vice president—engineering. Prior to becoming active in the company, Wilcox served the company as a management consultant. Dickinson has been with "Varec" for 8 years and has served as chief engineer of the electro-mechanical division.

Arnold A. Wilcox

Pont-a-Mousson Complete New Pipe Mill in France

Pontex Pipe Corporation's parent company, Pont-a-Mousson, has completed a new pipe mill in Belleville, France. The mill will feature a new system for making welded pipe. The French firm also recently completed a new seamless pipe plant near Rouen at a cost of $25 million.

Allis-Chalmers Manufacturing To Acquire Valley Iron Works

Allis-Chalmers Manufacturing Company will acquire assets of the Valley Iron Works Company of Appleton, Wis. Board of directors of both companies have approved the venture and only approval of Valley Iron Works stockholders is needed.

The Staytite Company Appoints C. A. Volosin Chief Engineer

C. Andrew Volosin has been named chief engineer and Stewart Perry becomes sales engineer for The Staytite Company. Before joining Staytite, Perry was associated with Delta Tank Mfg. Co., and McNamar Boiler and Tank Co.

Henry C. Tooley Appointed W-K-M Missouri City Plant Manager

Henry C. Tooley has been appointed plant manager for the Missouri City plant of W-K-M, division of ACF Industries, Inc. Tooley will be responsible for all manufacturing functions at the plant.

Tooley formerly was with Reed Roller Bit and later with Cameron Iron Works.

Donald E. Dixon Moves to Cooper-Bessemer Houston Office

Donald E. Dixon has been transferred to the Houston branch office by Cooper-Bessemer Corporation. Dixon, previously located at the sales office in Tulsa and main plant at Mount Vernon, Ohio, will work under Houston manager, Earl Martin.

Koppers Company, Inc., Promotes Pennington to General Manager

John W. Pennington has been promoted to general manager of the Piston Ring and Seal Department of the Metal Products Division of Koppers Company, Inc.

Pennington joined Koppers in 1950 as chief engineer of Piston Ring Department, was made manager of Technical Department in 1953 and manager of engineering and development for the division in 1956. From 1939 to 1950, he served with Caterpillar Tractor Company.

Koppers also announces appointment of William B. Sawers as manager of Coupling Department of the division. Sawers, who has been with the company since 1927 and in 1933, was appointed assistant chief engineer of the Piston Ring Department. In 1950 he was named assistant manager of the Piston Ring and Seal Department.

Thomas R. Watson Appointed Crane Co. Washington Manager

Thomas R. Watson has been named manager of the Washington, D. C., branch of Crane Co. He succeeds K. D. Ackad who will become a Crane distributor at Falls Church, Va.

Watson joined the company in 1954 in Pittsburgh, Pa., and was named assistant manager there in 1958.

CLASSIFIED ADVERTISING

PIPE

500,000 ft. 10¾" O.D. 35#
200,000 ft. 8⅝" O.D. 28½#
100,000 ft. 12¾" O.D. 40#
20,000 ft. 16" O.D. 42#
all No. 1 grade, plain end cleaned.

INDIANA-OHIO PIPE CO.
P. O. Box 5412 Shepard Sta.
Phone C.L. 3-5527. Columbus 3, Ohio

SALESMAN WANTED

Well-established successful firm has opening in an expanding sales department for young man looking for an opportunity in sales work. Must be college graduate, not over 33, in good health, ambitious and not afraid of work. Oil industry experience desirable. The man we are looking for will be trained at home office before moving into sales work on basis of salary plus commission incentive and traveling expenses. Our own personnel know of this advertisement. Your reply will be confidential and should be sufficiently complete to merit contacting you for an interview. Address Box 56-P, PIPE LINE INDUSTRY, Houston, Texas.

DRAGLINE MATS

Any Length, Width or Built to Specifications

We build them a little better for a little less

STRICTLY HARDWOOD
Also LUMBER and PILING

KENT PILING CO., INC.

T. W. "TOM" KENT, PRESIDENT
Phone Day: Amite 2641 — 2644
Night: 8454
FLUKER, LOUISIANA

IF YOU USE VALVES

YOU NEED THIS CATALOG!

Kerotest has been producing highest quality valves for the past 50 years for customers all over the world. Our new catalog—just off the press—gives dimensions, specifications and working tables to help you specify the right valves for refinery, industrial and marine applications.

Send for your copy—today!

KEROTEST

KEROTEST MANUFACTURING COMPANY
2512 LIBERTY AVENUE · PITTSBURGH 22, PA.

What's New in EQUIPMENT

Power Shift Transmission

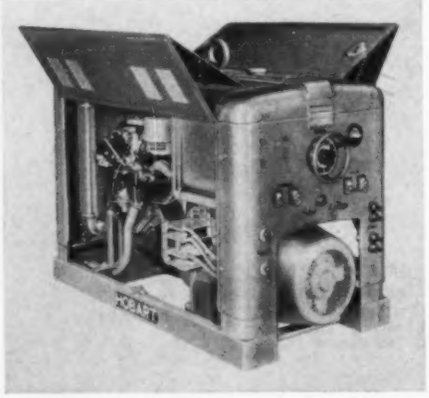
Caterpillar Tractor Co. announces the introduction of power shift transmissions on the D8, D9 and No. 583 pipe layer. The main unit of the transmission is a planetary gear set, driven integrally by the engine flywheel, which transmits one-third of the engine torque directly to the transmission input shaft, and the remaining engine torque through the torque converter. Horsepower on the tractors and pipelayer has been increased. The D8 and 583 are boosted to 235 and D9 to 335.

By directing a portion of engine torque straight to the transmission input shaft, the Cat design provides higher over-all efficiency. It also retains the impact force necessary in stumping and ripping operations. The remainder of the engine power is directed through the torque converter, allowing the tractor to automatically adjust travel speed to load. Engine stalling under heavy lug conditions is reduced and interaction of mechanical and torque converter drives also reduces tendency of machine to lunge when suddenly releasing a load.

New power shift allows operator to quickly shift down under an increasing load; then, without loss of speed or power, shift up to optimum load-speed in drifting to the fill. The units have a three-speed forward, three-speed reverse, planetary transmission. Transmission consists of five in-line gear trains, each with a separate clutch.

(This item supplements Caterpillar Tractor Co. data on pages 76-79 of the Pipe Line Catalog, Second Revision.)

For more data, circle **No. E1** on Readers' Service Card, last page this issue.



Welder and Power Unit

Hobart Brothers Co. announces a new gasoline engine combination arc welder and power unit. It is designed especially as a source of power for tungsten-inert-gas-shielded arc welding in the field where normal power is not available.

The unit has only one engine and only one generator, but provides current for either AC or DC welding. It is rated 250 amps, 30 volts for DC welding and 300 amps, 30 volts for AC welding. It can be used as a source of single phase, 110/220-volt AC power of 10kw capacity. Multiple current is made possible by a stator which contains two windings, one for AC and the other DC.

For more data, circle **No. E2** on Readers' Service Card, last page this issue.

Ford Trucks—1960

The 1960 Ford trucks now coming off the assembly line include light, medium, heavy and extra-heavy models.

Power source for Ford's light trucks includes the improved 223 cubic inch, 6-cylinder, economy engine and Ford's 292 cubic inch V-8. All 1960 Ford trucks offer modern short-stroke engines and a wide range of gear ratios and transmissions to provide proper road speeds at lower rpm for improved fuel economy and longer engine life.

Ford's 1960 heavy and extra-heavy truck line offers heavier axles than were standard in the past. These new optional axles give the 1960 Ford trucks a higher maximum GVW rating than ever before and effect every F and C series in the heavy-duty line.

Five different engines are available in the 1960 heavy and extra-heavy truck line including Ford's Super Duty V-8 engines for extreme heavy-duty work.

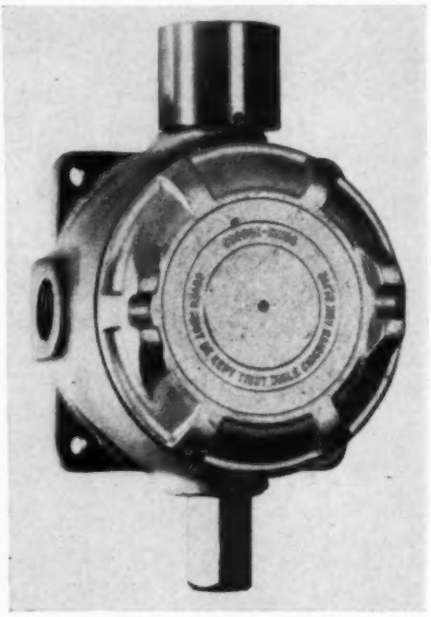
For more data, circle **No. E3** on Readers' Service Card, last page this issue.

Felt Insulation

For use in high temperature industrial equipment, Baldwin-Ehret-Hill, Inc., has developed a line of spun mineral wool felt insulations. Felts are available in densities ranging from 3 to 18 pounds per cubic foot and a variety of surface facings.

Lightweight and resilient, the felt insulation is incombustible, non-corrosive and moisture-resistant.

For more data, circle **No. E4** on Readers' Service Card, last page this issue.

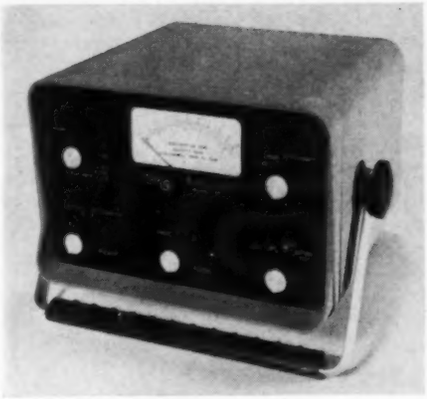


Pressure Control

United Electric Controls Company has introduced its type H98 explosion-proof pressure control for compressor stations.

The control incorporates wide range-high pressure, easy adjustment-tamper-proof, and mounting flexibility features. It can be applied for operating ranges from 10 to 1700 psi, with 3,500 psi maximum pressure protection. The unit is now available.

For more data, circle **No. E5** on Readers' Service Card, last page this issue.

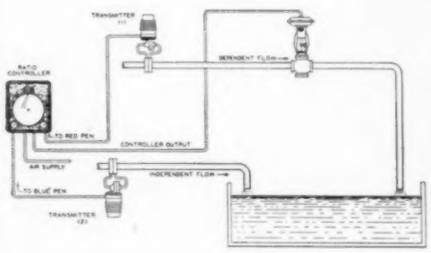


Vibration Meter

A completely portable, battery powered, transistorized vibration meter is introduced by Southwestern Industrial Electronics Co. The T-1A unit furnishes direct readings of the velocity, displacement amplitude and acceleration components of vibration, and, from simple computation, its frequency.

The meter can accept up to six simultaneous transducer outputs—three for velocity-type pickups, three for crystal accelerometers—one output at a time being selected as desired.

For more data, circle **No. E6** on Readers' Service Card, last page this issue.



Ratio Controller

A new 6,000 series ratio controller addition to its instrument line has been announced by Mason-Neilan, Division of Worthington Corporation. The controller has two primary elements, a control mechanism and a ratio unit actuated by changes in the independent variable. The ratio unit consists of a linkage which varies the control point of the dependent variable with changes in the independent variable.

(This item supplements Mason-Neilan data on pages 277-280 of the Pipe Line Catalog, Second Revision.)

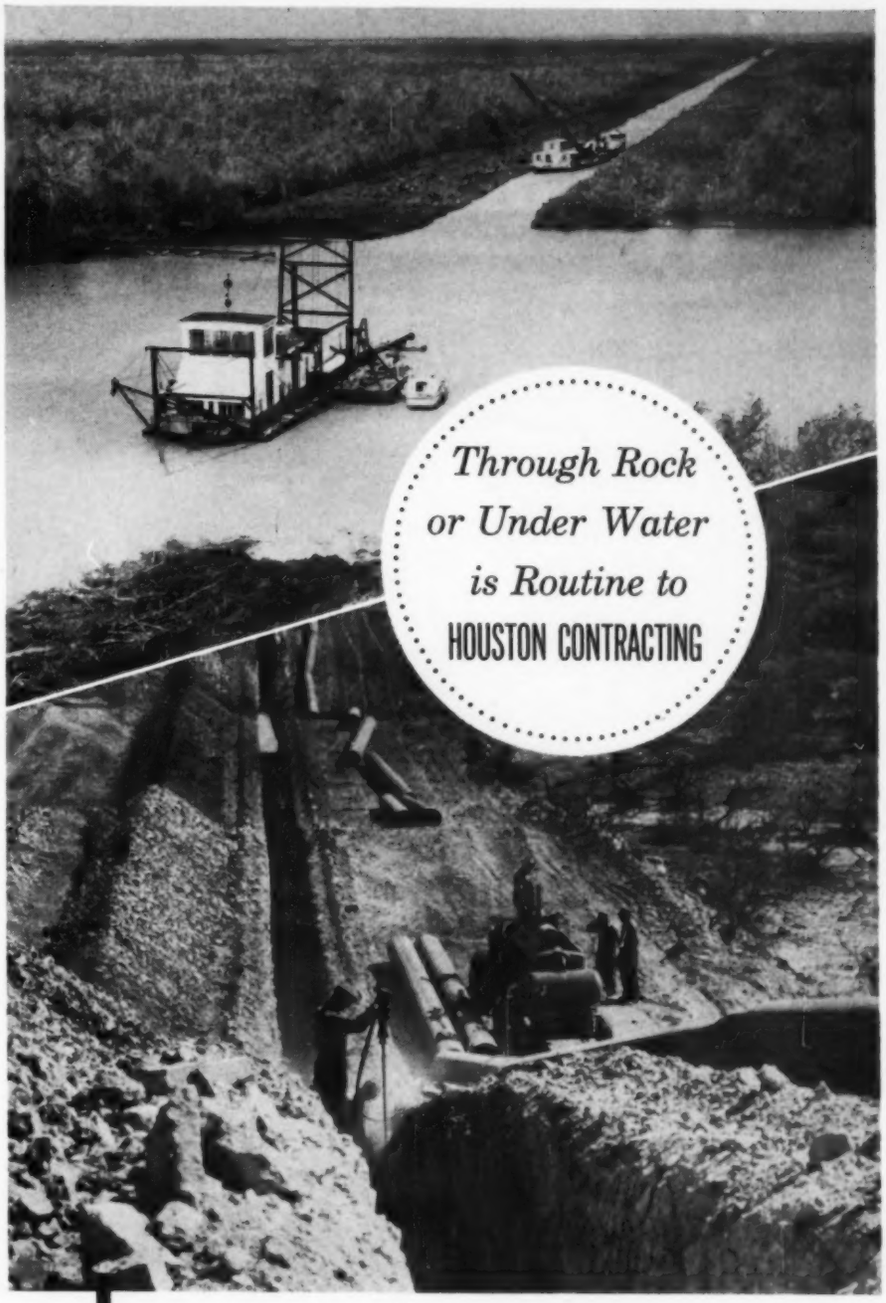
For more data, circle **No. E7** on Readers' Service Card, last page this issue.

Spur Gear Hoist

Coffing Hoist Division of Duff-Norton Company announces its 22-pound, CA-10 model spur gear hoist. Compact and with low headroom, the ½-ton aluminum hoist has eight-foot standard lift.

The load sheave, which carries the suspended load, is heat-treated for long wear and is mounted in two heavy ball bearings enclosed and protected from dirt. The automatic load brake securely holds the load in any position for accurate load spotting. Both load and hand chains are plated for durability.

For more data, circle **No. E8** on Readers' Service Card, last page this issue.



Well known for their unexcelled experience in the marshlands, Houston Contracting is equally adept at handling the problems encountered in all types of terrain. Swamp gumbo, rock, sand, and frozen ground, all have given way to Houston. If it's pipelining, Houston Contracting can do it efficiently and on schedule.

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103

For more data on advertised products, use Readers' Service Cards, last page.

NOW...selenium rectifiers with an unlimited life span!

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ANOTHER ACHIEVEMENT OF GENERAL INSTRUMENT CORPORATION

Tri-Amp

the only selenium rectifier with

NO ARTIFICIAL BARRIER LAYER

plus superior overload characteristics • higher current ratings • lower forward voltage drop • no sudden failures • no special protective devices required • smaller size • operate in parallel or in series without special precautions

Tri-Amp is a new and completely different concept in selenium. No artificial barrier layer of any kind is used, thus eliminating the cause of aging and high voltage drop. Result is the finest rectifier ever made.

Rectification in the Radio Receptor Tri-Amp is accomplished through a P-N junction formed by a closely controlled diffusion process involving the use of cadmium-selenide and tellurium. We'll be glad to send you more complete information on this important development. Write today to Section PLI-1.

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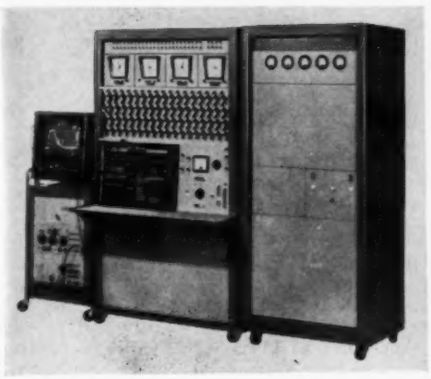
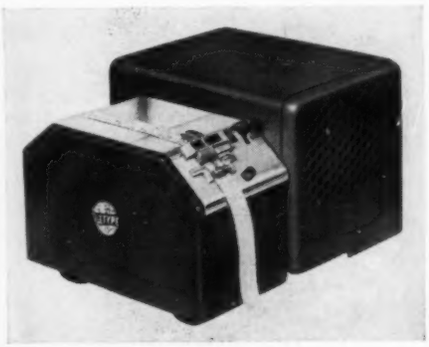


Analog Computer

Computer Systems, Inc., announces a general purpose analog computer incorporating high-speed memory and automatic iteration capability.

Designated the DYSTAC (Dynamic Memory & Storage Computer), the system features advantages of both analog and digital computers. The new system can solve process problems theoretically and then be applied directly to the control of that process. All logic elements operate with a frequency response adequate for 50 solutions per second. Basic units are available with 48 amplifiers, field-expandable to 80 operational amplifiers.

For more data, circle **No. E9** on Readers' Service Card, last page this issue.



Tape Reader Set

A punched-tape reader-set, including transmitter-distributor, motor, base and cover, compact and lightweight has been developed by Teletype Corporation.

The Model 28 Miniaturized LXD set measures 5⅞ inches in height, 7½ inches in width and 9½ inches in depth. The set is designed for wide range of readings including on-line data transmission over existing communications facilities and off-line control of tape-operated factory or office machines.

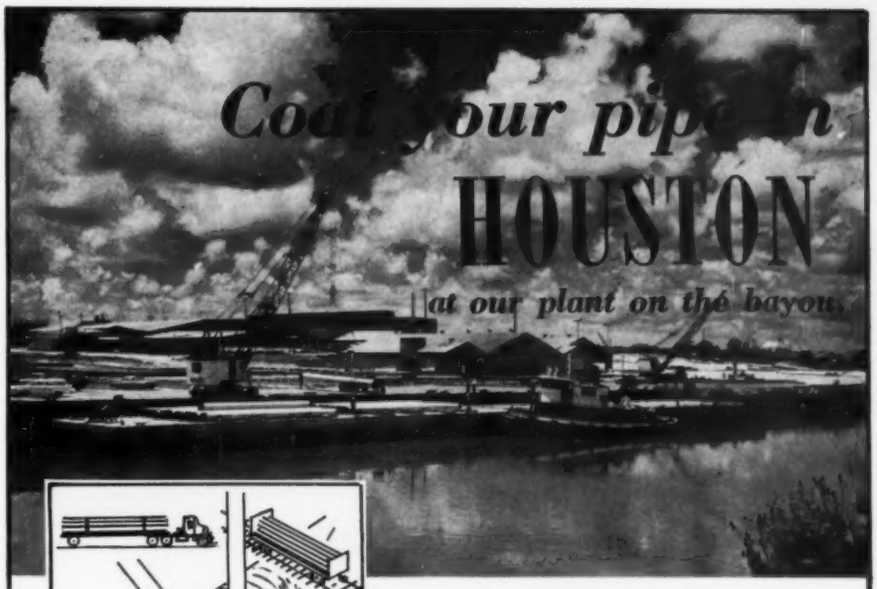
For more data, circle **No. E10** on Readers' Service Card, last page this issue.

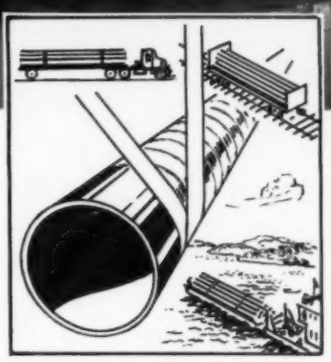
Proportioning Pump

An electrically driven, positive displacement chemical proportioning pump for accurate proportioning of chemical solutions is offered by B-I-F Industries, Inc.

The Chem-O-Feeder, Model 1210, features a corrosion-resistant transparent plastic head, hypalon diaphragm and check valves and a straight-through flow design.

For more data, circle **No. E11** on Readers' Service Card, last page this issue.





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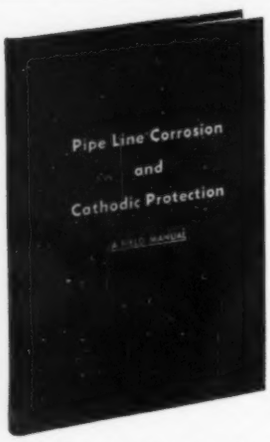

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This book is designed as a practical field manual. It provides workable methods that can save you valuable time and effort in obtaining interpretive field data.

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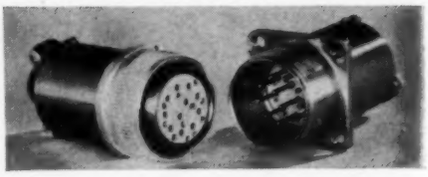
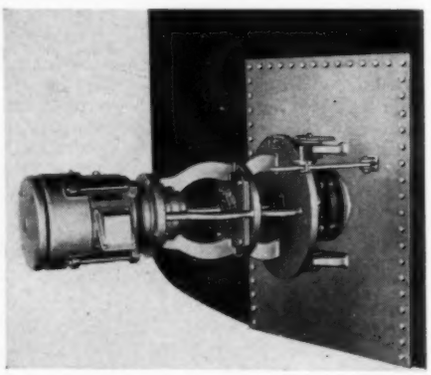


Thermocouple Connectors

A new line of thermocouple connectors with ceramic inserts designed to withstand temperatures up to 1,000° F has been developed by Harco Laboratories, Inc.

Models are available in 5, 9 and 11 contact configurations within a shell of 1¼-inch outside diameter.

For more data, circle **No. E12** on Readers' Service Card, last page this issue.



Lease Tank Mixer

Developed to re-suspend paraffin in 500 through 3,000 barrel tanks, Jensen Engineering Company's lease tank mixer is especially adaptable where it is desirous to keep tanks in continuous service.

Units are mounted in cover plates which fit standard clean-out doors. The drive unit is readily separable from the tank unit and a single driver may be used on several tanks at one location. Mixer entrance can be quickly changed through a total of 40°. Four sizes are available with motors of 1, 1.5, 2 and 3 hp.

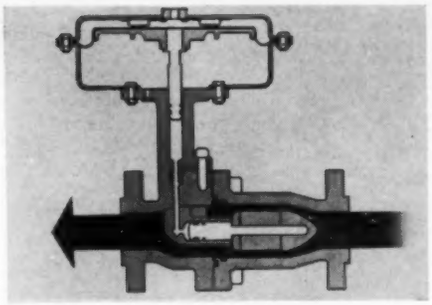
For more data, circle **No. E13** on Readers' Service Card, last page this issue.

Scraper Cup

T. D. Williamson, Inc., has developed a new pipe line scraper cup designated Taprseal. The cup is fabricated from a new compound specially developed to retain its physical properties under normal operating conditions. Designed to eliminate high stress points, the cups range from 2-inch through 36-inch sizes.

(This item supplements T. D. Williamson, Inc. data on Pages 529-532 of the Pipe Line Catalog, Second Revision.)

For more data, circle **No. E14** on Readers' Service Card, last page this issue.



Jet Stream Regulator

A new jet stream pressure reducing gas regulator with laminar flow and positive shutoff is announced by APCO, Division of Textron, Inc.

Laminar flow eliminates jetting of high speed gas and transient particles into the side of the regulator and also reduces sound vibrations. Its hydraulically actuated slave piston regulates flows with extremely fine control. The jet stream can be regulated from full flow to bubble-tight shutoff in three seconds. The regulator is an expansion type, pneumatic-hydraulic regulator, incorporating conventional controls, and a diaphragm motor as the actuating power source.

For more data, circle No. **E15** on Readers' Service Card, last page this issue.

Vinyl Tape

Minnesota Mining and Manufacturing Co. has introduced a vinyl pipe protection tape designed specifically for wrapping straight pipe sections. The "Scotchrap" brand pipe protection tape No. X-1102 combines a vinyl with a high tack adhesive with extra internal strength to eliminate tape displacement caused by movement of soil or pipe.

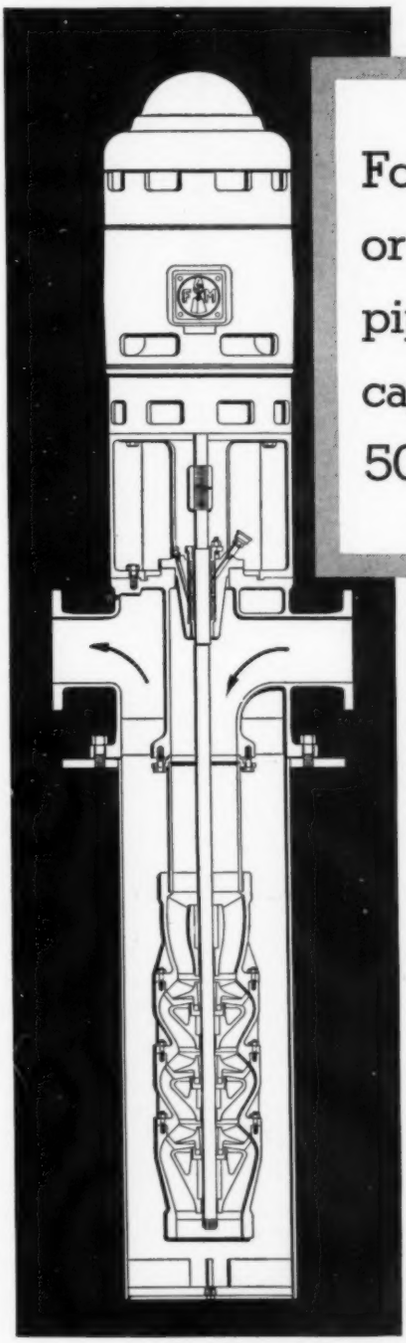
For more data, circle **No. E16** on Readers' Service Card, last page this issue.

Plastic Coating

A plast-a-coat touch-up compound to cover exposed areas in threads and cover joints has been introduced by Crouse-Hinds Company. Acids, alkalies, greases and oils will not affect plast-a-coated condulets. The corrosion resistant material adheres to the condulet surface and has good resistance to abrasion.

For more data, circle **No. E17** on Readers' Service Card, last page this issue.

NEW Fairbanks-Morse Inverted Pot-Type Turbine Pump for pipeline service



For crude
or product at
pipeline pressures,
capacities to
50,000 bbl. per day

This advanced-design pump cuts initial and operating costs 4 ways: (1) Rugged, uncomplicated construction—only one moving part. (2) High-pressure packing problems are minimized—the packing gland is in the suction line. (3) Permits increasing pressures without decreasing capacities. (4) Minimizes maintenance with recognized Fairbanks-Morse quality, including denser, tougher Pomoloy cast iron and lifetime Fairmortected surfaces.

Installations may be single or in series, depending on specific components selected for head capacity requirements. Power may be F-M direct electric drive, or right-angle drive with F-M motor or O-P diesel.

For complete information on the new Inverted Pot-Type Turbine Injection Pump, write Fairbanks, Morse & Co., Oilfield Division, 1713 N. Market St., Dallas 2, Texas.

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New Equipment Literature

For more data on New Equipment or copies of Catalogs and Literature reviewed in this issue, use the Reader Service postcards just inside the back cover and facing the Advertisers' Index. Simply circle code numbers of items desired—sign and mail card.

Quick Transportation

Petroleum Helicopters, Inc., has published a brochure describing its service to the petroleum industry. The helicopters are useful for transporting personnel to offshore working areas and sections inland without access roads.

To get a copy, circle **No. E18** on Readers' Service Card, last page this issue.

Welding Manual

A manual featuring its full line of gas welding, cutting, and allied equipment has been published by Smith Welding Equipment Corporation. The highly illustrated, 40-page booklet carries photographs of equipment, charts and technical data on the various items.

To get a copy, circle **No. E19** on Readers' Service Card, last page this issue.

Electronic Control

A new bulletin on electronic control for the petroleum and process industries, "A Functional Guide to Autronic Control Equipment," has been published by the Swartwout Co.

Main feature of the bulletin is a large illustrated chart on which all the major system components are arranged functionally to enable the reader to quickly see what control instrumentation is available for a given process variable.

To get a copy, circle **No. E20** on Readers' Service Card, last page this issue.

Portable Compressors

All weather operation and other features of six models of rotary portable air compressors, ranging from 85 to 900 cfm, are described in the new Gardner-Denver Company bulletin, "Rotary Portable Compressors."

The 8-page pamphlet gives specifications for small 85 cfm air-cooled Model RP85 as well as the five larger water cooled compressors.

To get a copy, circle **No. E21** on Readers' Service Card, last page this issue.

Liquisonic Controller

Custom Controls, Inc., has published a 10-page bulletin on its liquisonic controller. The controller is a transistorized ultra-sonic device designed for liquid level control. The operating principle, which uses no moving parts, makes it versatile, accurate and extremely dependable. It is insensitive to gases, vapors, temperature variations, shocks and variations and is applicable to level detections of all liquids, slurries and granular solids. Transducers are coated with a ceramic glaze and mounted on teflon probes.

To get a copy, circle **No. E22** on Readers' Service Card, last page this issue.

Synchronous Generators

A four-page bulletin has been published by Allis-Chalmers on its packaged brushless synchronous generators. A combination of brushless excitation system and static voltage regulation control provides the key to the generator's design. Commutators and brushes are replaced by silicon rectifiers. Generators assure low harmonic content under all load conditions.

To get a copy, circle **No. E23** on Readers' Service Card, last page this issue.

Caterpillar Tractors

Five undercarriage components for Cat D8 tractors, available as replacement parts, are discussed in a 6-page brochure, "New Track Options For Your D8 Tractors," recently released by Caterpillar Tractor Co.

Components include a track hardware, boralloy replacement rims, track shoes, larger diameter pins and bushings and longer, higher track links.

To get a copy, circle **No. E24** on Readers' Service Card, last page this issue.

Mass Flowmeter

Theory, operation and advantages of industrial flowmeter that measures flow of fuels, industrial liquids and gases directly in pounds, is described in an 8-page General Electric bulletin. The bulletin includes photographs, specifications, dimensions and cutaway drawings illustrating principles of operation.

To get a copy, circle **No. E25** on Readers' Service Card, last page this issue.

Corrosion Protection

The F. W. Gartner Company has issued a catalog containing fliers on its methods for protection of iron and steel against corrosion. The firm specializes in protective coatings from atmospheric to high heat corrosion.

To get a copy, circle **No. E26** on Readers' Service Card, last page this issue.

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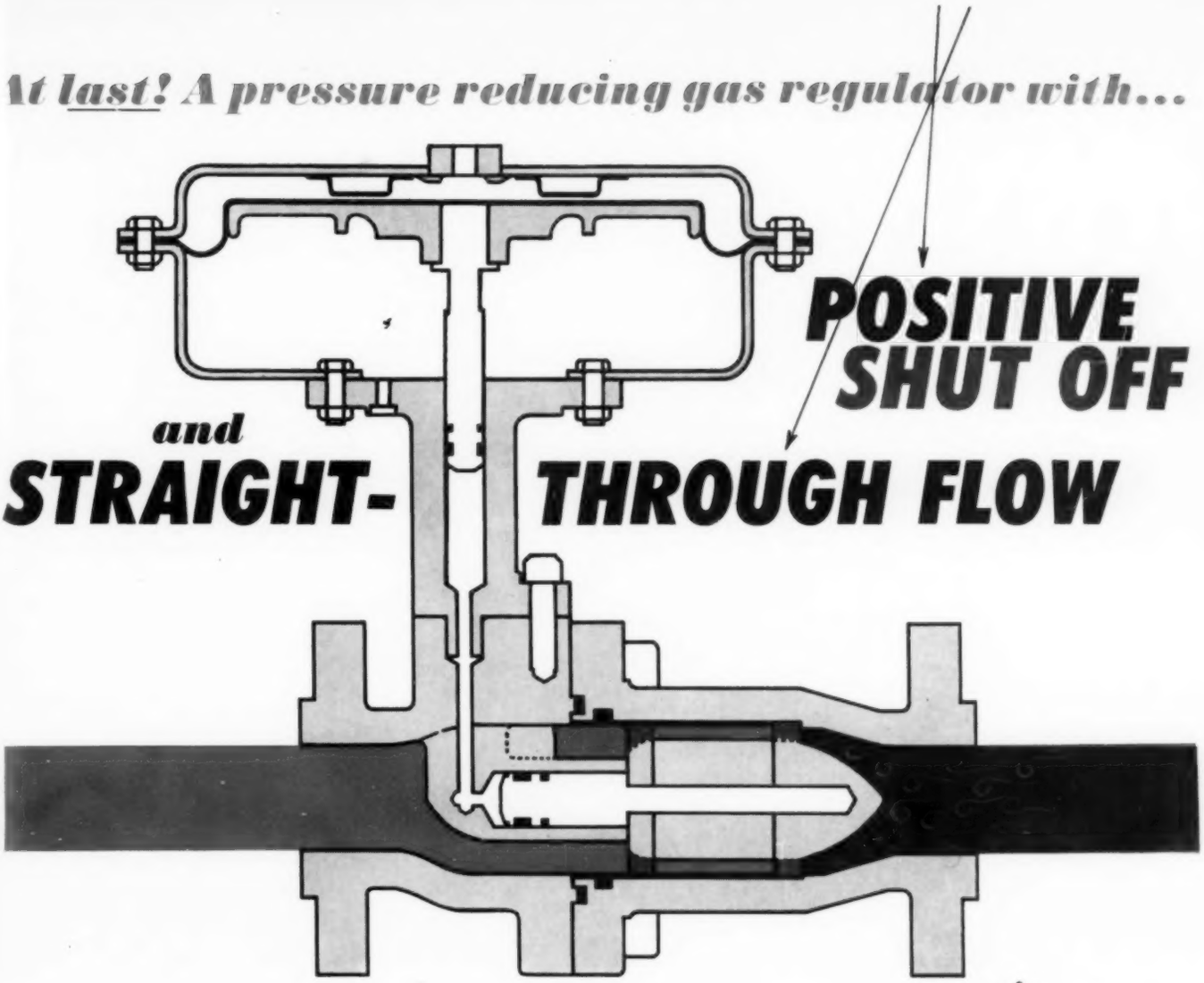
At last! A pressure reducing gas regulator with...



POSITIVE SHUT OFF

and

STRAIGHT-THROUGH FLOW

The NEW Jet Stream Regulator

Now you can stop high-speed gas turbulence, sound vibration, and leakage in your pressure regulators. The Jet Stream Regulator gives you straight-through laminar flow, positive shutoff, and no mechanical friction. Jet Stream's laminar flow stops the jetting of high speed gas and transient particles. This smooth straight-through flow also reduces sound vibration. Jet Stream's hydraulically actuated slave piston regulates flows with extremely fine control . . . from full flow to bubble-tight shutoff in three seconds. For efficiency and safety in your pressure reducing gas regulators . . . *use a Jet Stream Regulator!*

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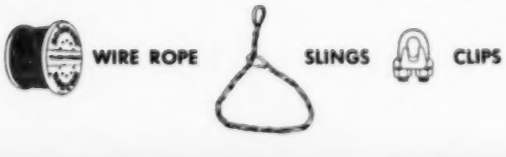

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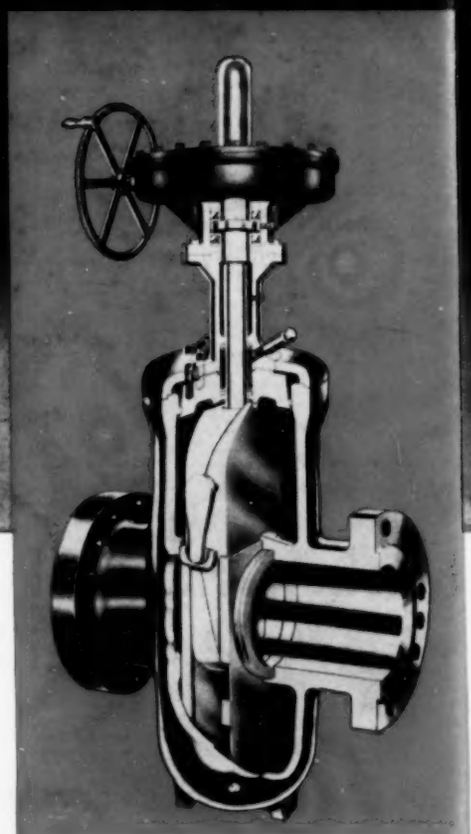

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